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IN THIS ISSUE

White Grubs, Soil Moisture, and Drought

Daniel A. Potter

Soil moisture is probably the most important factor determining the distribution and abundance of white grubs in turf. Severe drought had the eastern United States in a withering grip, and non-irrigated lawns and golf roughs have been brown and dormant through much of the summer. How will these conditions affect grub populations this year, and what about next summer?

Recall that white grubs are the larvae of stout-bodied beetles called scarabs, a group that includes native masked chafers, May and June beetles, and black turfgrass ataenius, as well as exotic species such as Japanese beetle, European chafer, Oriental beetle, and Asiatic garden beetle. All of these beetles lay their eggs in moist soil, typically 1 to 2 in. (2.5–5 cm) under turf or pasture grasses. Small and oval when first laid, scarab eggs enlarge and become nearly spherical after absorbing water from surrounding soil. **Eggs will shrivel and die if soil moisture drops below about 10%. The tiny, newly hatched grubs also are unlikely to survive in very dry soils.**

Not surprisingly, rainfall and irrigation also affect behavior of the adult beetles. If drought occurs during the weeks before adults normally appear, **the newly mature, unmated beetles may remain underground, their emergence delayed until rain softens and wets the ground. The first heavy downpour often triggers the onset of intense flight and mating activity.**

Once mated, females seek out moist grassland in which to lay eggs. Some species, e.g., Japanese beetles, may fly a half mile (0.8 km) or more in search of suitable egg-laying sites. My research has shown that **egg-laden females are attracted to irrigated turf, particularly when surrounding areas are dry.** Thus, irrigated lawns and fairways will often have relatively high densities of grubs. **On golf courses where fairways are protected by preventive grub treatments, this often translates into moist, untreated areas such as tee banks, green banks, and close, irrigated rough having the highest grub populations.**

Once the grubs are about half-grown, irrigation or rainfall begin to work in the turf manager's favor. Moist soils in August and September mask the feeding damage and encourage regrowth of roots. **Whereas irrigated turf often will tolerate 12 or more grubs per ft^2 (0.1 m^2) before showing injury, the same turf may be damaged by half that number if the grass is additionally stressed by drought.**

Large grubs tend to move deeper when soils become dry. When applying curative grub treatments (e.g., Dylox or Turcam) to relatively dry turf in late summer, irrigating a day or two *before* application may help to draw the grubs closer to the surface. This increases their contact with the insecticide residues and often provides better control. Of course, post-treatment watering is still needed to leach the residues into the root zone.

The drought of 1999 likely caused widespread mortality of eggs and young grubs in non-irrigated turf and pastures, so overall grub populations may be lower next year. But, don't let your guard down. Beetles that emerge from irrigated turf often lay eggs in the same areas, so your perennial grub "hot spots" will still be at risk.

FEATURE ARTICLE

Post-Drought Stress Recovery of Turfgrasses

James B Beard

Drought stress has been extraordinarily severe in the eastern and midwestern states of the cool, humid climatic region in the United States during 1999. Under normal field conditions the combination of severe drought and heat stress occurring in combination can be particularly devastating, especially if irrigation is not practiced. Typically the turf will turn brown and enter a summer dormancy period under these conditions. The morphology of a turfgrass species or cultivar can significantly affect the degree of drought stress survival. **The noncreeping bunch types are most prone to damage, the stoloniferous types intermediate, and the rhizomatous types the best in ability to survive extended summer dormancy periods caused principally by drought stress.** This is attributed to the semi-resting dormant meristematic areas or buds on rhizomes and stolons, which possess a particularly high degree of drought hardiness. The comparative drought resistance of 24 turfgrasses is summarized in the accompanying table.

ENHANCING SUMMER DORMANCY SURVIVAL

There are cultural practices that can contribute to the increased potential of turfgrasses to survive an extended summer drought stress, if implemented during the predormancy hardening period of increasingly progressive stress and slowing of shoot growth. **These cultural factors involve avoiding excessive shoot growth stimulation during the hardening period.** They include (a) **moderate to low nitrogen fertilization rates,** which provide only enough nitrogen to avoid a nutrient stress, (b) **high potassium levels,** and (c) **deep, infrequent irrigations,** which enhance root growth and avoid a succulent tissue condition.

POST-DROUGHT STRESS RECOVERY

Typically, the tissues surviving an extended summer drought stress are the meristematic areas on the rhizomes, stolons, and crowns of certain turfgrass species. During the drought stress period these meristematic tissues continue to respire and use stored carbohydrates, which may gradually become exhausted. The first environmental component essential to the initiation of shoot growth following an extended summer dormancy period is the availability of water in the soil as a result of rainfall. **Once this shoot growth is stimulated by rainfall, it is important to follow cultural practices that accentuate the rate of carbohydrate production for recovery of the root and shoot systems.** This involves (a) **the use of moderate to low nitrogen nutritional levels** that are sufficient to avoid chlorosis from nitrogen stress, (b) **sustaining high plant available potassium and iron levels,** and (c) **higher mowing heights,** which aid in more rapid recovery. Once an upcoming rainy period is apparent, the use of core cultivation, slicing, or spiking is needed to loosen the turf-soil surface, which may have become relatively impermeable and compacted from intense traffic. This maximizes the amount of water infiltrated into the root zone and available for uptake into the plant. Finally, the control of many seriously threatening disease, or insect pests during this critical recovery period can be important to the ultimate survival of the turf.

PLANT SURVIVAL ASSESSMENT

It is important to assess the degree of plant survival from an extended drought stress period. A common technique is to **collect a set of 4 to 6 inch (10–15 cm) diameter turfed plugs from representative dormant sites** within the turf area of concern. Then **place them in a moist environment that is favorable for turfgrass growth,** including a temperature of 65 to 70°F (16–21°C) for cool-season turfgrasses and 86 to 90°F (30–32°C) for warm-season turfgrasses. **The amount and density of shoot emergence and regrowth in a timely manner is a good indicator of potential survival for the entire turf area.** An additional assessment technique involves collecting individual plants and cutting longitudinal cross sections through the nodes of the rhizomes and stolons, plus the crowns, and observing their condition. Brown tissue that is brittle and easily fractured is an indicator of death, whereas a white, firm, somewhat moist tissue indicates survival at that point in time. It is critical to make these single point assessments in multiple locations over the area to ensure that a representative area has been monitored.

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FEATURE ARTICLE

1999 Was a Big Year for Spring Dead Spot

Peter H. Dernoeden

Spring dead spot (SDS) is perhaps the most damaging disease of bermudagrass (*Cynodon* spp.) turf. This disease is caused by at least three root pathogens, including *Ophiospaerella korrae, O. herpotricha,* and *O. namari. Gaeumannomyces graminis* var. *graminis* is associated with both spring dead spot and bermudagrass decline in southern states. **The intensity of SDS varies greatly from year to year, and it seems impossible to predict those years when it will be severe.** Indeed, turf pathologists are baffled by the unpredictable nature of SDS outbreaks. The disease is generally more severe following mild and wet winters, but there seem to be many exceptions to this rule. For example, the SDS outbreak in the eastern United States in 1999 was extremely severe. The winter of 1998–1999 was initially cold and wet, but late winter was relatively mild. Conversely, the winter of 1997–1998 was mild and wet, yet the severity of SDS in the spring of 1998 was generally low. **Hence, severe outbreaks of SDS are due to imperfectly understood environmental and soil conditions, as well as the fact that three different species of *Ophiosphaerella* may be involved in the SDS complex in some regions.** Furthermore, soil fertility and pH, and some herbicides, also may potentially impact SDS severity.

As the name implies, SDS injury becomes apparent in the spring. **The actual infection probably begins in early autumn, but root injury by the pathogen becomes rapid just prior to spring green-up.** As bermudagrass breaks dormancy, circular patches of tan or brown sunken turf a few inches (5 cm) to three feet (0.9 m) or greater in diameter become conspicuous. Rhizomes and stolons from nearby healthy plants eventually spread into and cover the dead patches. This filling-in process is slow, a period that may last four to eight weeks or longer following spring green-up. The slowness of the filling-in process is believed to be due to toxic substances generated by the pathogen(s) in the thatch or soil below the dead patches. Weeds commonly invade the dead patches. These weeds should be eliminated to reduce competition with the bermudagrass, which helps to speed the turf recovery process.

Spring dead spot can be extremely destructive to bermudagrass under both low and high maintenance. Recovery, however, is very slow in turf maintained with low levels of nitrogen. The disease is most commonly associated with bermudagrass turf older than three years, but it may appear the spring following sprigging with stolons from sites previously affected with SDS. **Spring dead spot injury is most likely to occur where thick thatch layers exist and where high application rates of nitrogen fertilizers were applied during late summer or autumn.**

MANAGEMENT

Cultivars of bermudagrass with greater winter hardiness such as "Midiron," "Midfield," and "Vamont" tend to be less susceptible and generally recover more rapidly from SDS. "Tufcote" and most bermudagrass hybrids (*Cynodon dactylon* x *C. transvaalensis*) are very susceptible to this disease. It is important to eliminate weeds from diseased sites, as their presence will slow, and in some cases prevent, a complete recovery of the bermudagrass. **Ammonium sulfate or ammonium chloride (applied at 1.0 lb N/1000 ft; 50 kg N/ha) and potassium chloride (applied at 1.0 lb K/1000 ft; 50 kg N/ha) applied at monthly intervals from mid-May to mid-August speed the recovery of turf injured by SDS, and help to alleviate disease severity over time.** The suppression effect provided by the aforementioned acidifying fertilizer, however, may take three or more years to develop. Acidification alone, however, may not reduce the number of patches, but it does reduce their size. **It is important, however, to cease nitrogen application about six weeks prior to the anticipated dormancy of bermudagrass.** This is because the application of significant amounts of nitrogen in early autumn has been linked to an increase in SDS severity the following spring. **Nitrate forms of nitrogen, such as sodium nitrate, potassium nitrate, and calcium nitrate, should be avoided.** This is because nitrate forms of nitrogen tend to increase soil pH in the root zone, and have been shown to intensify SDS. According to Vincelli and Williams (1998), sulfur also reduces SDS. They suggested using ammonium-based fertilizers with a low rate of sulfur, such as 2.0 lb S/1000 ft^2 (100 kg S/ha) per year. Higher rates of sulfur in their study, however, caused slower spring green-up and thinning of the stand. Potassium can improve low-temperature stress hardiness, and research results suggest that potassium chloride may help to reduce SDS and improve bermudagrass quality. Irrigate frequently and maintain nitrogen applications during dry periods in the summer to encourage re-growth by stolons and rhizomes. **Higher-cut bermudagrass is not as severely damaged by SDS.** Hence, it is helpful to increase the mowing height as much as possible for the site (i.e., green, fairway, athletic field, etc.) about 30 days prior to dormancy. It also is beneficial to control thatch and to alleviate soil compaction by core cultivation and vertical cutting in the summer, when the bermudagrass is actively growing.

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...Drought Stress...

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The relative drought resistance of 24 turfgrasses*, when grown in their respective regions of adaptation.

Relative Ranking	Turfgrass
superior	dactylon bermudagrass† hybrid bermudagrass† seashore paspalum
excellent	kikuyugrass zoysiagrasses American buffalograss bahiagrass
good	crested wheatgrass St. Augustinegrass† centipedegrass common carpetgrass tropical carpetgrass
medium	tall fescue perennial ryegrass Kentucky bluegrass
fair	creeping bentgrass hard fescue Chewings fescue red fescues
poor	colonial bentgrass creeping bluegrass annual bluegrass
very poor	annual ryegrass rough bluegrass

*Based on the most widely used cultivars of each species.
†Significant variability occurs among cultivars within the species.

...Spring Dead Spot

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Azoxystrobin (Heritage®), fenarimol (Rubigan®), myclobutanil (Eagle®), propiconazole (Banner MAXX®), and triadimefon (Bayleton®) have been shown to suppress SDS. **A fungicide should be applied once or twice in mid to late September or about 30 days prior to anticipated winter dormancy.** Fungicides, however, do not provide complete SDS control, and one application usually provides nearly as good SDS suppression as multiple applications. **Control is typically erratic with any fungicide in any given year, with levels of SDS suppression often ranging from 0 to 75%.** As noted previously, complete control with fungicides is seldom, if ever, achieved. **There is no benefit to be gained by applying a fungicide at spring green-up, because most of the root and stolon damage occurs prior to green-up.** Fungicides should be applied in at least 100 and preferably 200 gallons of water per acre. High water dilutions help move the fungicide down to stolons or between leaf sheaths to make contact with vital growing points. Currently, there are no data to support the premise that watering-in of a fungicide to the root zone will improve SDS control. Indeed, bermudagrass generally loses most of its existing root system at spring green-up. Hence, it would appear that protecting stolons and stems, which can live for one or more years, is the correct target for a fungicide. Therefore, until field research demonstrates otherwise, these fungicides probably should not be watered-in.

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Rust Problems Increase in Midwest

In a recent conversation with Dr. Joe Vargas of Michigan State University, he indicated that **increased turf damage has been observed on numerous Kentucky bluegrass (*Poa pratensis*) lawns in Michigan and the contiguous midwestern states that is being caused by rust (*Puccinia* spp.).** These general field observations indicate that the injury is occurring on a broad range of cultivars of Kentucky bluegrass, although there is a need for detailed studies in this regard, as well as a need to address the specific causal pathogen or pathogens involved.

The rust-causing pathogens are obligate-parasitic fungi, which have a distinct sexual cycle, as contrasted to the imperfect fungi, which have an asexual cycle only. The existence of the sexual cycle allows the heterogeneous *Puccinia* pathogens to develop new races of the fungus to which the existing turfgrass cultivars may not be resistant. The development of new races of *Puccinia* is a well-known, periodic occurrence in certain small grains. Specific investigations are needed to confirm whether this in fact is occurring. **If this is the case, there will be a need to develop new Kentucky bluegrass cultivars that have resistance to the newly emerging races of the *Puccinia* fungus.**

FEATURE ARTICLE

Hurricanes and Flooding Problems

James B Beard

The hurricane season in the Atlantic Ocean has brought major flooding problems to eastern North America. The high winds associated with hurricanes typically result in the downing and uprooting of trees. This may result in the need for extensive debris removal from turf areas where tree limbs and various materials torn from buildings and other constructed facilities are strewn. This wood, metal, and similar debris should be removed as soon as possible in order to avoid interference with mowing operations and potential turf injury by light exclusion.

SOIL DEPOSITION

The dimension of hurricanes that can create the most injury to turfgrasses is the very intense rainfall and resultant flooding of turf areas. Recent intense rains on the east coast of the United States ranged from 10 inches (25 cm) to as high as 25 inches (63.5 cm) in less than 1 day. The lateral water flow from slopes onto lower areas of the floodwaters results in the deposition of soil, including clay, silt, and salt. **Salt deposited on the grass leaves should be washed off as soon as possible to prevent physiological desiccation and death of the turfgrass plants.** The deposition of clay and/or silt creates a fine-textured layer that is prone to compaction and can become relatively impermeable to downward soil water infiltration for years to come. Thus, **the removal of this soil deposition as soon as possible is very important, especially from high-sand root zones on putting greens and tees.** The thin layer of soil remaining after mechanical removal of thicker layers should be washed off to the extent possible using water that is pressurized and directed through large-volume hoses.

SUBMERSION INJURY

Flooding that persists for an extended period of time can cause the death of certain turfgrasses. **Complete submersion under water can result in soil oxygen depletion within a matter of hours.** This may result in death of the root hairs and subsequent yellowing of the turfgrass plants due to a nitrogen or iron deficiency. Ultimately, death of the turfgrass plant may occur by one of several mechanisms, including (a) a build-up of certain toxic compounds, such as ferrous and sulfide ions formed by reduction of anaerobic soil conditions, (b) the accumulation of toxic organic compounds, such as methane or carbon dioxide produced by the decomposition of soil organic matter, and (c) the accumulation of toxic by-products within the plant tissue under anaerobic conditions.

The relative degree of injury to turfgrass from submergence varies depending on the (a) turfgrass species, (b) submergence duration, (c) submergence depth, (d) water temperature, and (e) light intensity. The relative submersion tolerance of twenty turfgrasses is shown in the accompanying table. Submersion at high water temperatures of 86°F (30°C) can result in death of the fine leaf fescues (*Festuca* spp.) in one day, whereas creeping bentgrasses (*Agrostis stolonifera*) may survive more than 60 days submergence at low water temperatures of 50°F (10°C). Accordingly, **it is important to use submersion-tolerant turfgrass species on sites that are subject to frequent flooding.**

The extent of injury from submergence increases with increases in the depth of water coverage. Grasses with leaves extending above the water surface are able to survive much longer than if totally submerged. Also, **grasses under stagnant or standing water are more likely to be killed than when under flowing water.** However, one of the most important factors in the degree of injury that occurs during flooding is the actual water temperature. **The extent of death increases dramatically as the water temperature increases from 50°F (10°C) to 80°F (27°C).** Thus, submersion early in the year at cooler water temperatures is less likely to cause turfgrass injury than submersion later in the summer when water temperatures are high, and especially when also exposed to cloud-free, full-radiant sunlight levels.

INJURY ASSESSMENT

Once the debris is collected and any soil deposition removed as completely as possible, the next step is to assess the extent of damage to the turfgrass, which may appear as a totally brown canopy. Individual plants of the desired turfgrass species from numerous locations

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Hurricanes and Flooding...

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under flooding should be lifted out and examined carefully. **Cut a horizontal cross section through the grass crowns and the nodes on lateral stems to determine if they are white, firm, and healthy, or brown, mushy, and dead.** This will be an indicator of the amount of turfgrass recovery that can be anticipated. **Numerous multiple samplings are critical to get a representative assessment.** Then the decision must be made whether replanting of critical turf areas will be required to repair the damage. Removal of any dead turf plant material and thatch from the surface is important to avoid a future organic layer problem. If soil deposition has occurred, fairly intense core cultivation will aid in disrupting the clay or silt layer that has developed. The usual establishment procedures can then be followed.

The relative submersion tolerance of 20 turfgrasses.

Relative Submersion Tolerance	Turfgrass
excellent	seashore paspalum
	American buffalograss
	dactylon bermudagrass
	creeping bentgrass
	hybrid bermudagrass
good	tropical carpetgrass
	St. Augustinegrass
	turf timothy
	rough bluegrass
	tall fescue
	common carpetgrass
medium	meadow fescue
	Kentucky bluegrass
fair	crested wheatgrass
	annual bluegrass
	perennial ryegrass
poor	annual ryegrass
	red fescue
	hard fescue
	centipedegrass

Natural Organic Chelating Agents for Plant Nutrients

The organic matter component in soils is vital to a quality, living root zone. **It contributes significantly to adequate soil aeration, water retention, water movement, and nutrient availability, as well as providing a resilient upper root zone, which is important in the playing quality of numerous sport surfaces.** Organic matter also is a key substrate required for sustaining the life of numerous soil organisms, including bacteria, fungi, and actinomyces. In addition, the ongoing decomposition process of dead plant organic matter such as roots contributes to the recycling of plant nutrients. The soil organic matter content depends on the rate of soil organic matter accumulation relative to the decomposition rate. Grasses are known to be very effective in terms of a positive contribution to soil organic matter through their high-density, fibrous root system, which continues to grow and be replaced in a perennial manner.

Perhaps one of the least recognized and understood **beneficial contributions of organic matter is in providing organic compounds that function as natural chelating agents for a number of essential plant nutrients. Iron (Fe), manganese (Mn), copper (Cu), and zinc (Zn) become more soluble and plant-available in the soil solution by complexing with one of the numerous organic compounds.** In addition, these nutrients naturally chelated by the organic compounds are more easily moved to the uptake sites on the plant root hairs. Without the presence of these natural organic chelating agents both iron and manganese tend to be chemically bound in unavailable forms, while both copper and zinc are inherently water insoluble.

Some individuals advocate that the addition of organic matter in new high-sand root zone constructions is not needed, because it will eventually be formed through root decomposition. While roots will eventually contribute significantly to the soil organic matter content, the lack of needed organic compounds in the early developmental stages of the turf can result in significant turfgrass nutrient stresses that delay proper rooting and turf development. Thus, this natural chelating is one of a number of beneficial effects from organic matter that justify the inclusion of an organic matter component in the original high-sand root zone construction. In addition, it emphasizes the importance of developing an active, living root system in all soil textures, which will contribute significantly to a sustained, acceptable level of organic matter within the soil root zone.

RESEARCH SUMMARY

The Influence of Fertilization Timing on Typhula Blight Occurrence

Typhula blight or gray snow mold (*Typhula* spp.) can be a major problem on bentgrass (*Agrostis* spp.) turfs in the cooler climatic regions. A two-year investigation was conducted to assess the influence of various timings of nitrogen fertilization on the incidence of typhula blight.

The experimental site was at Boyne Highlands near Harbor Springs, Michigan, which is on a similar latitude to Minneapolis, Minnesota. The experimental site was a closely mowed Penncross creeping bentgrass (*Agrostis stolonifera*) turf on a large grass tennis court area. The root zone was a native sandy soil with a pH of 6.5. The turf was maintained at a cutting height of 0.5 inch (13 mm) and irrigated as needed to prevent visual wilt. Fungicides had not been applied to the experimental area during the previous spring and summer growing season.

The treatment timings consisted of nitrogen fertilizer applications on August 15th, September 15th, October 15th, and November 15th at rates of 0.5 and 1.0 pound per 1,000 square feet (0.25 and 0.5 kg/100 m^2). The plot size was 6 by 10 feet (1.8 x 3 m) with 4 replications in a randomized block design.

Results. The typhula blight occurrence was very uniform across the experimental area, ranging from 40 to 95% damage, depending on the specific treatment. **A fertilizer timing on September 15th resulted in a doubling of typhula blight incidence, when compared to fertilization applications made either 30 days before or after the September 15th timing.** This dramatic negative response indicates that the timing of nitrogen fertilization can have a major influence on the severity of typhula blight occurrence. Avoiding the September nitrogen fertilization would also translate to enhanced ease of fungicide control for this disease. Are other diseases of turfgrasses also influenced by the timing of nitrogen fertilization? **by James B Beard and David P. Martin. Turfgrass Research Report, Michigan State University.**

Communicating Seasonal Timing

The terminology for timing of cultural practices frequently involves the use of terms such as early fall, late fall, and late spring. Point in fact this creates a confusing situation. The actual definition of fall is the season when leaves fall from certain trees. The more correct terminology is to use the word **autumn—which is defined as the season between summer and winter, extending from the September 23 equinox to the December 22 solstice, in the northern hemisphere.** If the seeding of cool-season turfgrasses is recommended for early fall, this would represent the last week in September and the first 2 weeks in October, when in fact the preferred timing would be late summer, involving the first 3 weeks of September in many climatic regions. Similarly, the term late fall fertilization would imply the first 3 weeks in December, when in fact the intended communication is for a period in the range of 6 to 8 weeks earlier, depending on the climatic region.

Finally, **spring is defined as a season between winter and summer, which is the period from the March 21 equinox to the June 22 solstice, in the northern hemisphere.** It is important to use the correct terminology in relation to spring, particularly in guidelines concerning the timing of planting warm-season turfgrasses and the initial post-winter fertilization timing.

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JB COMMENTS

Interpreting Cultivar Assessments for Putting Greens

Penncross creeping bentgrass (*Agrostis stolonifera*) and Tifdwarf hybrid bermudagrass (*Cynodon dactylon* x *C. transvaalensis*) have been the dominant cultivars of choice for use on putting greens in the cool and warm climatic regions, respectively, for many decades. More recently, a number of new cultivars of both species have been introduced, including very high-density types that are adapted to extraordinarily close mowing and also some intermediate types. Consequently, a great deal of interest has been generated concerning research assessments of these new cultivars.

As one reviews the research data conducted under putting green conditions, **it is important to know the particular cutting height and mowing frequency utilized, as well as the nitrogen fertility program maintained relative to the type of root zone utilized.** With this information, one can assess the results relative to the particular cutting height and fertility level desired on any specific golf course. Unfortunately, there is a lot of research being published on putting green cultivar performance from various locations that does not indicate the cutting height and/or nitrogen fertility program practiced. This negates its practical usefulness.

Cutting height strongly influences the ball roll distance or speed achieved on putting greens. The trend on many golf courses has been to the very high speeds achieved by close mowing of from 3.6 to 2.5 mm (9/64–1/10 in.). There are other golf facilities, such as lower-budget public golf courses, where intermediate speeds and higher cutting heights may be preferred. **If high speeds are desired, it is important to make decisions concerning cultivar performance based on research methods where the turf has been maintained at the same close mowing heights.** At the lower cutting heights, lowering the cutting height by just 0.8 mm (1/32 in.) in a study can result in a distinct separation in cultivar performance among either the hybrid bermudagrass or the creeping bentgrass cultivars.

The nitrogen fertility level also is an important consideration in cultivar selection. Generally, the preference should be for cultivars that have a lower nitrogen fertility requirement. **Among the newer cultivars released, the nitrogen requirement can vary from 4- to 6-fold in the case of the hybrid bermudagrasses and 2- to 4-fold in the case of the creeping bentgrasses.** Typically, both Penncross and Tifdwarf bermudagrass have been maintained at relatively high nitrogen fertility levels. Many of the current cultivar assessments ongoing are utilizing the traditional nitrogen fertility rates. **Under these situations the cultivars with one-sixth to one-fourth the nitrogen requirement being used, as expected, will form a high biomass/thatch accumulation, which is objectionable.** In contrast, **utilizing the lower nitrogen fertility requirement of certain cultivars will result in minimal thatch accumulation, especially if combined with a very close cutting height.** Thus, in assessing studies addressing the potential biomass/thatch accumulation problems of certain cultivars, it is important to consider the nitrogen fertility level and cutting height used in the experiment.

ASK DR. BEARD

Q *A turfgrass newly planted on a high-sand root zone initially had good rooting, but subsequently exhibited a distinct loss of roots. What is the problem?*

A **The key in this situation is sustaining nutrient availability in a high-sand root zone over an extended period of time.** Preplant fertilization of both major and minor nutrients is normally practiced prior to seeding or sod transplanting. Initial root development is good if proper preplant fertilization has been provided.

Subsequently, the root system may decline and the aboveground shoot growth may slow. **Quite commonly this is due to a lack of essential plant-available nutrients caused by rapid downward leaching of the water-soluble nutrients from the surface root zone.** This nutrient leaching is particularly severe in high-sand root zones, and may be accelerated even more by excessive irrigation. The key in irrigation of a high-sand root zone with a perched hydration construction is to replace only that soil water that has been lost by evapotranspiration. Any water applied in excess of this amount simply is flushed through the root zone, which in turn also accelerates the leaching of water-soluble nutrients.

A second dimension in this nutrient stress development is the inability of many controlled-release fertilizers to effectively release the essential elements, because there is a lack of microorganisms needed for the decomposition and nutrient release process.

Clearly, the solution is to avoid applying excessive amounts of water and to practice timely applications of all appropriate essential nutrients as needed. Frequently, **a safe approach in terms of ensuring plant nutrient availability in the initial 2 to 3 months with a high-sand root zone is weekly foliar applications of a complete soluble fertilizer containing a full compliment of both macro- and micronutrients.**

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