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IN THIS ISSUE

Golf Course Closings and Frost Delays on Putting Greens

James B Beard

Closing a golf course is one of the most difficult and emotional questions faced by the golf course staff. It adversely affects cash flow in all departments and may create dissension among the golfing clientele.

A primary reason for closing a golf course is adverse weather conditions. Many factors influence the decision. Since most of these factors call for personal judgment, the decision is frequently disputed. This is especially true if the reasons are not clearly understood. Even though judgment is involved, **the decision should be based on all available facts, with the best long-term interests of the entire golfing clientele and the golf course condition being the primary governing factors.**

The final decision is the responsibility of either the green committee chair, who has direct responsibility to the membership for maintenance of the course, or the owner or designated authority, in the case of privately owned clubs. The decision is strongly influenced by and usually solely dependent on the judgment of the golf course superintendent. The properly trained, experienced golf course superintendent is capable of rendering expert professional advice on the subject and has the capability to recognize the myriad factors that influence the future well-being of a turf and its playability that are not recognized or understood by golfers. Thus, **as a practical solution, the decision-making responsibility usually is delegated to the golf course superintendent.**

Traffic Stresses. There are two main detrimental effects that result from traffic stress on golf course turf: (a) **soil compaction,** the extent of which is determined by the pressure per unit area exerted on the soil, and (b) **turfgrass wear stress** from abrasive action on grass shoots.

Bare feet are particularly destructive to putting greens in terms of soil compaction, as are both boots and shoes with small heels. This is because the body weight is exerted on a relatively small turfed surface area. Also, body weight that is distributed largely on the spike shoulders of regular golf shoes causes more damage than is the case of golf shoes with recessed spike shoulders or spikeless golf shoes with modest knobs.

Hand-pulled and electric hand golf carts exert more pounds of pressure per square inch than do most riding 3- or 4-wheel powered golf carts. For this reason, **hand-pulled carts should be under the same operating restrictions as are powered golf carts.** The abrasive action of powered golf cart tires in turning, starting, and stopping makes these carts more likely to injure a turf than is the case for hand-pulled carts, especially on fairways. However, hand-pulled carts are more often found in inappropriate areas.

Adverse Weather Conditions. Weather has adverse effects on both the turfgrass and the underlying soil. Such effects are further aggravated by traffic over wet areas. The

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Dealing with Skunk and Raccoon Problems in Turf

Daniel A. Potter

Although it isn't listed on the Chinese zodiac, 1998 might appropriately be remembered as the Year of the Skunk. **Many golf superintendents reported increased problems with skunks and raccoons tearing up turf.** Whether or not these varmints really are on the rise is uncertain. Let's examine some of the reasons why skunks and raccoons become a problem for turf managers, and what can be done about it.

Skunks and raccoons are omnivorous, eating both animal and plant material. **Favorite skunk foods are white grubs, cutworms, and other plump insects.** They'll also eat earthworms, crawfish, small rodents, moles and shrews, frogs and toads, bird eggs and nestlings, fish, fruits, and garbage. Raccoons have a similar varied diet. Favored haunts for skunks include woodland edges, woody ravines, brush piles, weedy fields, rocky outcrops, and drainage ditches. Skunks are nocturnal, becoming active from sunset to shortly after sunrise. During the day, they sleep in dens that usually are below ground, but sometimes are in hollow logs or tree stumps, brush, or lumber piles. Raccoons prefer to live near streams, lakes, or marshes, but may venture away from bodies of water. Like skunks, they are nocturnal. They do not dig dens of their own, preferring to nest in hollow trees or logs, abandoned burrows of other animals, or other natural shelters. Both skunks and raccoons sometimes take up residence beneath porches, patio decks, or outbuildings.

Superintendents usually can coexist with these varmints until they start tearing up large patches of grub-infested turf. **Once they find a suitable feeding area, skunks and raccoons will return night after night until the food supply is depleted.** Damage to turf is worst in spring and autumn, when white grubs are large and close to the surface. Skunks also leave behind tell-tale golf ball-sized, cone-shaped pits when digging out individual grubs.

Unlike moles, which eat only earthworms and insects, skunks and raccoons like a varied diet and can easily forage elsewhere. **Controlling white grubs reduces the food supply and usually discourages their digging.**

The new soil insecticides, imadacloprid (Merit®) and halofenozide (Mach 2®) generally provide excellent grub control when applied preventively, before egg hatch. **Indeed, because these insecticides are so effective at reducing grub populations in treated fairways, I believe that their use may actually concentrate the digging by skunks and raccoons seeking "leftover" grubs in adjacent, irrigated rough.** I've seen golf holes where the fairways were virtually grub-free, but the bordering irrigated rough appeared to have been rototilled by skunks. Soil moisture generally is the main factor determining where grubs occur, because the female beetles are attracted to moist areas in which to lay their eggs. Thus, untreated, irrigated areas are likely to harbor grubs and attract predatory varmints.

One solution is to treat bordering, irrigated rough when applying preventive insecticides for grubs in tees and fairways. Another option is to spot-treat with a fast-acting, curative insecticide such as trichlorfon (Dylox®) at the first sign of grub damage or varmint digging. Posttreatment irrigation is needed to leach the residues through the thatch and into the soil. Research has shown that Merit is not very active against large grubs, and that Mach 2 will not kill them quickly enough to put a stop to digging by skunks and raccoons.

Managing the habitat may provide some relief from skunks and raccoons. Removing large hollow trees or logs, and wood or brush piles, and sealing access to crawl spaces or outdoor structures forces the varmints to go elsewhere for their cover and, hopefully, their meals.

Raccoons are considered protected furbearers in many states. Thus, you can hunt or trap them only during specified seasons set by local regulations. Often, a permit is required even for live-trapping an animal. It usually is legal to trap or kill skunks where a health threat exists or where damage occurs. Because laws vary from state to state, consult a game warden or your state wildlife agency to discuss your options.

Live-trapping can be an effective nonlethal method of getting rid of raccoons and skunks. Use Hav-a-hart®, Tomahawk®, or similar-type traps of the appropriate size. Effective baits for raccoons include chunks of corn-on-the-cob in the milk stage, sardines and other fish, and fish-flavored canned cat food. For skunks, try canned or fresh fish, fish-flavored cat food, chicken parts, bacon, or peanut butter on bread. Animals can be made less wary about entering a trap by providing natural footing on the trap floor. Do this by pushing the wire cage back and forth on the ground until the bottom mesh is covered with soil.

Traps containing a raccoon should be placed in a burlap sack or similar covering, and then transported at least five miles from the point of capture before releasing the animal. Skunks, obviously, are trickier to deal with. Approach slowly and cover the trap with an old blanket, plastic tarp, or burlap. Covering the trap before it is set is simpler and may even encourage the skunk to enter. Gently transfer the covered trap to the back of a pickup for transport. Striped skunks

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...Frost Delays...

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effect of traffic on soil compaction increases as the soil water content increases. At water saturation the soil becomes extremely pliable and prone to serious rutting. Puddles need not be present for the soil to be water saturated and compaction prone. Serious problems arising from soil compaction include (a) exclusion of oxygen needed to maintain root growth, (b) loss of water absorption and retention capabilities in the soil, (c) increased water loss by surface runoff, (d) loss of resilience, which affects the ability to hold a shot on a green, (d) destruction of surface smoothness, which may require weeks or even months to fully correct, (f) a wet surface and weakened turf that is more prone to disease, annual bluegrass (*Poa annua*) invasion, insect injury, and such environmental stresses as cold and heat, and (g) increased labor costs for corrective procedures, such as turf cultivation, topdressing, spiking, and overseeding.

The degree of soil compaction caused by traffic under wet conditions varies with the soil texture and drainage characteristics. Problems with soil compaction and rutting are more serious on fine-textured clayey soils and on areas where adequate drain lines and surface drainage have not been provided. In contrast, many sandy soils drain rapidly and traffic can be reintroduced sooner after an intense rain. Thus, it is possible for one golf course to be closed due to wet conditions while another nearby course is open, simply because of differences in soil texture and drainage characteristics.

Winter Play. Turfgrass damage from traffic stress may occur when there is frost on the ground, especially on putting greens. **Traffic pressure exerted on frozen leaves physically disrupts the tissues by mechanically fracturing the cells and causing death.** This damage occurs at a time of year when turfgrass recovery is unlikely, thus the detrimental effects are cumulative if such traffic stress is allowed to reoccur during the winter. **Frost can be removed relatively quickly by a light syringing if the temperature of the air and underlying soil profile are above freezing.** In most cases, it is preferable simply to close the golf course until the normal diurnal rise in temperature has melted both the surface frost and the frozen turfgrass shoots.

Play on putting greens when the turf-soil is solidly frozen causes less permanent damage if the grass is dormant and the greens remain frozen all day. However, the turf on greens may not stay frozen all day once play is allowed. **Should daytime surface thawing of the turf occur, golfer foot traffic may cause the turfgrass roots to be sheared at the interface between the lower frozen soil and the soft thawing sod.** This is a second winter condition that justifies closing the course, but it is one that is difficult for golfers to understand. For this reason, it may be better to keep the golf course closed for the day, if daytime thawing is anticipated.

One of the most critical times to close putting greens in colder climates is when the frost is melting in the soil profile. During this 1- to 2-week thaw period, foot traffic has been known to sink in up to 6 inches (150 mm) on very soft clayey greens. **As a general rule, cart traffic is best confined to cart paths during the winter, during spring thaws, and when spring transition occurs on dormant bermudagrass and zoysiagrass fairways.**

The Decision. The goal of good golf course maintenance is to have the golf course open and in optimal playing condition at all feasible times. Any decision that necessitates closing the course should be made carefully, using sound reasoning, and must take into consideration the good of the majority. The potential damage—both immediate and long term—of allowing play must be weighed very carefully against monetary losses and golfer dissatisfaction if play is prohibited. Unfortunately, the decision may not be easy to make and may involve a compromise, such as allowing foot traffic only or restricting golf carts to paths. The golf course superintendent's judgment, based on sound agronomic knowledge and experience, is vital in the decision-making process, especially when closure is contemplated due to unfavorable weather conditions.

...Skunks and Raccoons...

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are unlikely to release scent if kept in the darkened trap and handled in this manner. Trapped skunks can be drowned by submerging the covered trap in water for at least five minutes. Because of the potential for spreading rabies, trapped skunks should not be released elsewhere.

Be extremely careful if handling raccoons, and especially skunks, because of the possibility that they are rabid. Be especially wary of animals that look sick, wander around in daylight, or show no fear of humans—there is a good chance that they are rabid. If you are bitten, cleanse the wound with warm soapy water and seek medical care immediately. Try to capture or cage the animal, but don't shoot it in the head because the health department will need the head to determine if the animal was rabid.

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Why Putting Greens Appear Red or Purple in Winter and Spring

Peter H. Dernoeden

The first frosty nights in autumn bring about some pronounced physiological changes in plants. In creeping bentgrass (*Agrostis stolonifera*), especially on lower-cut putting greens, the leaves may develop a reddish-brown, purple, or blue-gray color. The discoloration may be uniform, but frequently the various shades of purple, red, or blue appear in circular patches. These patches constitute different clones within the bentgrass polystand. The colors are most prevalent on older greens, especially those seeded to Seaside or "South German" bentgrasses. These varieties were genetically variable and as a result not all plants emerging from seed were true to type. Hence, individual plants would grow and the more aggressive types would dominate to produce circular patches. These patches are not unlike the circular areas of blighted turf associated with some diseases. The purplish discoloration often is misdiagnosed as red leaf spot (*Drechslera erythrospila*) by some golf course superintendents. *Helminthosporium* diseases that cause leaf spot and melting-out are not commonplace on creeping bentgrass, but leaf lesioning can cause a reddish-brown discoloration and subsequent severe thinning in Kentucky bluegrass (*Poa pratensis*) and perennial ryegrass (*Lolium perenne*) turfs. The purpling from frost often is prominent in Penncross greens. Since Penncross has three parents, at least three different types of color patches or clones can appear on greens. Similar color changes can appear in older stands of Pennlinks, Southshore, Providence, and all of the newer seeded bentgrass cultivars. Some cultivars, such as Crenshaw, may display a more uniform, purplish color in winter. The same purple color also can occur in annual bluegrass (*Poa annua*), but seems to be more commonly associated with the perennial types rather than the annual types.

Why do putting green grasses turn red, blue, or purple? The cool to cold temperatures trigger the color responses. During mid to late October, many regions experience relatively warm days (65 to 75°F; 17 to 24°C), but cool nights (32 to 55°F; 0 to 13°C). The sunny, bright, and warm days stimulate plants to produce large amounts of sugars (through photosynthesis) in leaf blades and sheaths. At night, the sugars must be translocated out of the leaves to crowns for storage or use in other physiological processes. When nights are very cool or frosty the sugars are not completely moved out of the leaves and they accumulate. There are many types of sugars. Glucose is a common plant sugar and sometimes glucose molecules are chemically bound with anthocyanins. Anthocyanins are pigments and their function in plants is unclear. They provide the red, purple, and blue colors in flowers. Anthocyanins are always present in leaves, but normally are masked by the presence of chlorophyll. They are expressed in the foliage of trees during cool and bright weather to provide the spectacular colors in autumn leaves. Hence, bentgrasses may experience a similar accumulation of sugar, and therefore anthocyanins, following the first cool or frosty night of fall. Frost injury may denature the green chlorophyll, thereby exposing the anthocyanin pigment. These colors may intensify and persist throughout winter months and slowly disappear in mid-spring after the turf begins active growth.

A similar phenomenon can occur on bentgrass greens, tees, and fairways in the spring. This usually coincides with unseasonably warm temperatures in late winter or early spring, which stimulates a premature green-up of bentgrass and annual bluegrass. Should night temperatures plummet into the low 20s°F (–7°C), or if there are several nights of frost following a premature green-up, the bentgrass and annual bluegrass again may develop a reddish-brown, brick-red, or dark-purple color. This condition is aggravated by topdressing, brushing, core cultivation, foot traffic (especially around the hole, and in entrances and exit areas), and other grooming practices performed at the time cold temperatures recur following an early green-up. Use of plant growth regulators, and dry and windy weather further contribute to the reddening or purpling of creeping bentgrass. *Helminthosporium*-like lesions may develop on these leaves, but it should be noted that water-soaked leaf lesions can develop in response to many different kinds of injury mechanisms. Therefore, the lesions observed on red or purple leaves during cold periods most likely are caused by mechanical injury associated with grooming, topdressing, or mowing greens too early in the morning following a frosty night. The bentgrass will recover rapidly with the advent of consistently warmer weather (i.e., days >70°F; 21°C and night >45°F; 7°C). An application of about 0.1 to 0.2 lb N/1000 ft^2 (5 to 10 kg N/ha) from a water-soluble nitrogen source will speed recovery as daily temperatures rise.

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FEATURE ARTICLE

Drive 75 DF—A New Herbicide for 1999

Fred Yelverton

For the first time in several years, a new herbicide will be available for turfgrass managers in 1999. **Quinclorac (trade name Drive 75 DF)** was recently granted an EPA registration for use in residential and non-residential turf. Turfgrass weed scientists have been working with the product on an experimental basis for several years. Drive 75 DF, manufactured by the BASF Corporation, will be an additional tool to manage several weedy pests in turf. In addition, this product will be welcome news to turf managers in Florida and California because **Drive has activity on torpedograss (*Panicum repens*) and kikuyugrass (*Pennisetum clandestinum*).**

Drive should be applied postemergence to weeds. The herbicide is absorbed by foliage and roots and is translocated throughout the plant. Injury symptoms on susceptible plants include stem twisting, stunting, chlorosis, and gradual reddening, followed by necrosis and death. The following is a list of weeds that Drive will control:

- large and smooth crabgrasses
- field bindweed
- hop, red, and white clovers
- dollarweed
- kikuyugrass
- common, slender, and thymeleaf speedwells
- barnyardgrass
- black medic
- common dandelion
- giant, green, and yellow foxtails
- broadleaf signalgrass
- torpedograss

The application rate for Drive is one pound of product per acre (1.1 kg/ha) or 0.75 lb active ingredient/acre. Methylated seed oil or a crop oil concentrate must be added to the spray solution at 1.5 pints/acre or 2 pints/acre (28.5 or 38 mL/ha), respectively. Perhaps the most common use of Drive will be for postemergence control of crabgrass. In my research, I have obtained excellent postemergence control of crabgrass if applied when the crabgrass is small (prior to tillering) and when the weeds are actively growing. When applied to drought-stressed weeds, the result was poor control. Two applications of Drive will be needed to control kikuyugrass or torpedograss.

As with any herbicide, Drive has limitations. Drive has no activity on goosegrass. Also, as with all postemergence herbicides, **the smaller the weeds, the better the control.** Certain ornamental and other desirable plants are very sensitive to Drive. Plants in the Solanaceae family are very sensitive. These include tomatoes, eggplant, peppers, and tobacco, to name a few. As with any herbicide, consult the label for additional restrictions and precautions.

Drive will be a welcome addition in the management of weedy pests in turfgrasses. Postemergence herbicides are well suited for IPM programs in turf because you only treat where the weeds are a problem. This allows turfgrass managers to reduce herbicide inputs by treating only those areas that need treating. As with any herbicide, Drive should be tested on a limited basis until you get a good feel for weed control and turfgrass tolerance at your site.

Shown below is a list of turfgrass species and their tolerance to Drive:

Highly Tolerant	Moderately Tolerant	Susceptible
common bermudagrass	creeping bentgrass*	bahiagrass
Kentucky bluegrass	hybrid bermudagrass	centipedegrass
annual bluegrass	fine-leaf fescues (red, hard, Chewings)**	dichondra
American buffalograss		St. Augustinegrass
tall fescue		
annual ryegrass		
perennial ryegrass		
zoysiagrasses		

*Cannot be used on bentgrass collars and greens.
**Can only be applied to fine-leaf fescues when they are part of a blend.

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Despite the aforementioned explanation, many persist in believing that the reddish color of greens must be disease. After all, textbook photos or red leaf spot disease on greens depict symptoms almost identical to frost injury. To explain this better it may be helpful to review the *Helminthosporium* diseases and their incitants. Many of the fungi that cause leaf spotting and melting-out diseases of turfgrasses once belonged in the taxonomic genus *Helminthosporium.* Today, these fungi are more appropriately referred to as species of *Drechslera* or *Bipolaris.* Because these diseases have been known for decades as *Helminthosporium* leaf spot and melting-out, most people do not recognize names other than *"Helminthosporium."* Thus, *Helminthosporium* often is used as a generic name for all the *Drechslera* and *Bipolaris* species that can cause leaf spot or melting-out diseases. *Drechslera erythrospila* is the causal agent of red leaf spot. Most turfgrass pathologists (Couch, 1995; Smiley et al., 1992; Smith et al., 1989; and Vargas, 1994) agree that red leaf spot is a warm weather disease that develops in late spring or early summer. In Kentucky, Vincelli and Doney (1995) reported that colonial, brown top and dryland bentgrasses were very susceptible to red leaf spot, but all 15 cultivars of creeping bentgrass evaluated in their trial showed high levels of resistance to *D. erythrospila.* There are other *Drechslera* species known to be associated with bentgrasses; they include *D. catenaria* and *D. gigantea. D. catenaria* is the most likely species to attack bentgrass in the spring, especially Toronto creeping bentgrass. Since our diagnostic lab opened in 1980, none of the aforementioned *Drechslera* spp. have been associated with creeping bentgrass in Maryland. In mid-May of 1997, however, we did find *D. dictyoides* producing prodigious numbers of spores on senescent or dead leaves of Penncross creeping bentgrass from a new tee. The sodded Penncross turf also was heavily infected with yellow tuft disease. In this case, *D. dictyoides* likely was acting as an opportunistic saprophyte, because there were no lesions on green leaves and spores were only found on dying or dead leaves. We also find red leaf spot (*D. erythrospila*) in late May and June on colonial bentgrass.

Most reports of *Helminthosporium* diseases in *Agrostis* species have involved colonial bentgrass, redtop or vegetatively propagated creeping bentgrass (e.g., Toronto). Hence, the relative rarity of *Helminthosporium* diseases in creeping bentgrasses today may be due in part to better resistance in Penncross and the many newer cultivars released in recent years. Furthermore, the widespread usage of broad spectrum fungicides applied from late autumn to spring for controlling winter diseases on greens (e.g., snow molds) also may help explain why leaf spotting and melting-out diseases are uncommon in the spring on creeping bentgrass.

During the summer *Bipolaris sorokiniana* can attach bentgrass, but the melting-out phase is uncommon in creeping bentgrass. Colonial bentgrass, however, may exhibit melting-out in the summer, particularly when treated routinely with sterol-inhibitor (DMI) or benzimidazole fungicides. Again, this is probably due to the routine use of the aforementioned fungicides for combating summer diseases. Regardless, it is not unusual to find a few zonate lesions (i.e., circular to oblong, brownish-purple lesions with or without a tan spot in the center) produced in response to *B. sorokiniana* spore penetration on bentgrass leaves during summer stress periods.

Some golf course superintendents have reported seeing a positive response from a broad spectrum fungicide applied in the spring to red, frost-injured greens. This would be more convincing if an untreated strip were left for comparative purposes! Assuming, however, that a positive response occurs, it may be due to the chemical impacting populations of "weak," secondary pathogens or the activity of saprophytes. During cool weather, these organisms may be enhancing leaf senescence at a time when plants are not actively producing new leaves and tillers for replacement of either frost-damaged or naturally senescing leaf tissue.

A somewhat similar blackening or purpling of leaves also may be elicited by the following: iron applications, low soil phosphorus levels, ammonium sulfate application, high application rate of fungicides classified as sterol inhibitors, some plant growth regulators, and arsenic toxicity. These responses are well known and can occur at any time of the year.

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RESEARCH SUMMARY

Options for Potential Enhancement of Zoysiagrass Establishment

Zoysiagrass (*Zoysia* species) is well known for its very slow establishment from either sprigs or seed. Even the best of the cultivars, which is El Toro, does not establish at a desirable rate. Researchers at the University of Maryland have investigated various methods that might have potential for enhancing the rate of vegetative establishment of Meyer Japanese zoysiagrass (*Zoysia japonica*). The treatments included (a) urea nitrogen fertilization, (b) a biostimulator combination of auxin, cytokinin and iron, and (c) three preemergent herbicides, including oxadiazon and dithiopyr.

The results of the investigation revealed that monthly applications of nitrogen at 1 lb per 1,000 ft^2 (0.5 kg/100 m^2) during the growing season had no influence on the sprig establishment rate of zoysiagrass. **Treatments with a biostimulator containing an auxin, cytokinin, and iron combination applied either by soaking the sprigs prior to planting or by weekly sprays after broadcast sprigging had no effect on zoysiagrass establishment or on rooting.** In contrast, use of a postemergence herbicide generally enhanced zoysiagrass establishment under conditions of significant competition from smooth crabgrass (*Digitaria ischaemum*). **Both oxidiazon and dithiopyr provided similar levels of crabgrass control and enhanced the rate of zoysiagrass coverage.** However, the dithiopyr did reduce midsummer root growth of Meyer Japanese zoysiagrass.

Editor Comments. Gibberellin and certain other growth regulators are used for enhancing the vegetative establishment of woody ornamental cuttings. However, similar effectiveness of growth regulators for enhancing the vegetative sprig propagation of zoysiagrass has not yet been documented through research, including the previously described research. Other than maintaining adequate available soil moisture, the key practice that this editor has found effective in the enhancement of zoysiagrass establishment is frequent mowing at a cutting height of less than 25 mm (1 inch). **Source: Zoysiagrass establishment from sprigs following application of herbicides, nitrogen, and biostimulator. 1996. by M.J. Carroll, P.H. Dernoeden, and M.J. Krouse.** *HortScience.* 31(6):972-975.

JB COMMENTS

High- and Low-Density Cultivar Trade-Offs

Introduction of the new high density bentgrass (*Agrostis stolonifera*) and bermudagrass (hybrid *Cynodon*) cultivars for closely mowed putting greens is evolving similar to previous innovations involving key plant morphological changes. For example, in the 1960s a number of golf course superintendents presented talks at turf conferences and articles in publications stating that the new cultivar was a failure, while others expounded on its success. The main difference between these two views was that the former **failed to adjust to the cultural needs of the new cultivar morphology,** but rather chose to maintain it as it had traditionally been done. In contrast, the latter learned how to adjust the cultural program to meet the morphological needs of the new

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JB Comments

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cultivar. Similar diverse statements are now being made about the new high-density cultivars for putting greens mowed closely at under 5/32 inch (4 mm).

One negative statement currently being made is that the high-density cultivars have increased cultural requirements in terms of vertical cutting and high-density minitine use for canopy biomass management. The extent to which this is true depends on the intensity of nitrogen fertilization. With the lower-density cultivars there was a tendency to use higher nitrogen fertilization rates to produce more lateral shoots in an attempt to improve the shoot density at close cutting heights. The **new cultivars that have the genetic capability for a high shoot density do not necessarily require high nitrogen fertilization.** In fact, the high nitrogen fertilization may increase the need for more frequent vertical cutting.

A dimension being overlooked concerning the increased cultural inputs for the new cultivars is the trade-offs, in that the high shoot density—even under very close mowing—restricts sunlight penetration to the soil surface. This results in a substantial reduction in moss, algae, *Poa annua,* and other weed problems. These problems require significant labor, pesticide, and cultural inputs to correct when many of the lower-density cultivars are in use. As golf course superintendents rise higher on the cultural learning curve for those morphologically different cultivars, it may actually result in reduced labor, cultural, and chemical inputs than for the lower-density cultivars under very close mowing heights. Overriding all of these agronomic dimensions is the golfer response and preference in terms of superior uniformity of ball roll with a great diversity of higher speeds that can be produced relatively easily on putting greens.

ASK DR. BEARD

Q. I need to fertilize the turf in early spring. What is the appropriate timing?

A. As a general strategy, nitrogen fertilization should be moderate or avoided in early spring, as temperatures are particularly favorable for growth, especially for cool-season grasses. However, this question relates to a situation where the turf either has a nutrient deficiency that requires significant spring fertilization or else there is a key event or competition scheduled that dictates an early spring fertilization. The spring fertilization strategy typically applies to nitrogen. In contrast, phosphorus and potassium can be applied at any time in the spring, provided the soil is thawed so the nutrients enter the soil with minimum potential for lateral movement.

A typical scenario where problems arise involves an individual who applies the initial spring nitrogen fertilization on a calendar date. When no turf response occurs at the normal time interval, the individual then applies a second nitrogen fertilization, and even this one may fail to give the desired turf response. What the individual has failed to understand is that **spring shoot growth initiation is controlled by soil temperature and that the timing of nitrogen fertilization should be based on monitoring of soil temperatures rather than a calendar date.** Consequently, in the situation just described, when the soil temperature finally warms to the threshold level for shoot growth there is an explosion in leaf production associated with the excessive nitrogen fertilization. This can create serious problems in terms of poor rooting, increased diseases, and subsequent proneness to heat stress as the turfgrass nears the summer season.

The key in interpreting early spring nitrogen fertilization is to monitor the soil temperature, as it basically controls new shoot growth in the spring. **For C_3 cool-season turfgrasses significant shoot growth usually does not occur until soil temperatures rise above 50°F (10°C), with substantial shoot growth rates occurring above 55°F (13°C).** Spring nitrogen fertilization may stimulate a somewhat earlier spring green-up, but will have minimal effect on vertical shoot growth and on tillering, which provides shoot density. **In the case of C_4 warm-season turfgrasses, spring green-up occurs when soil temperatures at a 4-inch (100 mm) depth reach 64°F (18°C). Subsequent substantial shoot growth does not occur until soil temperatures are above 72°F (22°C).**

Finally, it is important to recognize that there are other factors which affect the rate of soil warming other than the seasonal climatic pattern. For example, closely mowed turfs warm up more rapidly than high-cut turfs, due to greater shoot biomass insulation. Also, poorly drained, wet soils warm up much more slowly than well-drained, drier soils due to the high specific heat of the water. Finally, dark-colored surfaces warm up more quickly than light-colored areas.

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