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IN THIS ISSUE

Roots—A Key Plant Health Indicator

James B Beard

One can interpret more about past cultural practices and potential future turf problems by examining the underground turfgrass root characteristics and root environment than by any other approach. A root examination is much more comprehensive if a 4 inch (100 mm) diameter root core is removed, examined, and then carefully broken up in progressive sections starting from the bottom, with each section also examined. Be sure to note the coloration of the roots, with white being healthy and actively growing, light-brown being functional, and thin/brown-to-black being very restricted to nonfunctional in terms of water and nutrient uptake. It behooves the turf manager to take the time to periodically examine the root profile and trends in growth and dieback at regular intervals throughout the year. It is amazing how many consultants conduct site visitations without ever examining the underground rooting aspects.

To properly conduct a root examination, **it is important to know the rooting characteristics of each turfgrass species involved, as well as how these root system characteristics vary seasonally throughout the year and finally how they are affected by various turfgrass cultural practices.** Thus, the following discussion will be oriented around these three crucial dimensions.

ROOT CHARACTERISTICS

The root systems of C_3 cool-season turfgrasses are characterized as fine, fibrous, and multibranching. Typically, the roots extend to depths no greater than 12 to 18 inches (300–450 mm), and under severe summer heat stress on closely mowed greens the roots may be less than 2 inches (50 mm) in depth. The closer the mowing height, the shorter the root system.

Rooting depth is a key dimension that is strongly affected by the cutting height and nitrogen nutritional level. **Higher mowing heights or moderate to low nitrogen levels have a positive effect on the root depth of C_3, cool-season turfgrasses.** The greater the rooting depth the greater the capability to take up moisture from a larger portion of the soil profile and thus the better the drought stress avoidance characteristics. The root density also is a significant characteristic which has a response pattern that is affected by environmental and soil factors similar to those of rooting depth.

TEMPERATURE EFFECTS

Seasonal variations in temperature have a strong effect on root growth, especially on the cool-season turfgrasses. **The soil temperatures for optimum root growth of most cool-season turfgrasses are in the range of 50 to 65°F (10–18°C).** Root growth gradually declines in terms of root initiation and growth extension rate as soil temperatures are increased or decreased from the optimum range. At soil

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Roots...

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temperatures above 80°F (27°C) there is a drastic decline in root growth caused by enhanced maturation or aging of the existing roots and a cessation of new root initiation.

In contrast to the temperature optimum for root growth being in the range of 50 to 65°F (10–18°C), **the temperatures for optimum shoot growth of most cool-season turfgrasses are in the range of 60 to 75°F (16–24°C).** A very distinct difference. Also, the maximum and minimum temperatures for root growth are lower than those for shoot growth, with cell division in the root tips of Kentucky bluegrass (*Poa pratensis*) having been observed at temperatures just above 32°F (0°C). In contrast, creeping bentgrass (*Agrostis stolonifera*) produces very little root growth at suboptimal temperatures, which results in most of the root replacement from summer heat stress loss occurring during the following spring.

Mowing and Fertilization. The proper mowing frequency and a moderate to low nitrogen fertility level are particularly important for cool-season turfgrasses during the optimum root and shoot growth temperatures of the spring period. It is critical to maintain a mowing frequency that removes no more than one-third of the leaf area at any one time. Allowing the grass to grow excessively tall and then removing a major portion of the leaf that approaches a scalping effect, can result in a dieback of the root system. This is caused by a sink-source relationship in which the carbohydrates are mobilized to support the needed leaf growth recovery, thereby causing the dieback of the root system due to a carbohydrate deficiency. Similarly in the case of cool-season turfgrasses, a nitrogen application rate exceeding 0.8 pound per 1,000 ft^2 (0.4 kg/100 m^2) per application of a water soluble nitrogen carrier causes excessive leaf growth that can not be supported by normal photosynthetic rates. As a result, carbohydrate partitioning causes the shoots to have priority for the available carbohydrates, with no carbohydrates allocated for root growth which thereby may result in root dieback.

Thus, the proper mowing frequency and moderate to low nitrogen fertilization are very critical during this peak spring shoot growth period, just prior to entering the summer high-temperature stress period. To do otherwise would cause a loss of the root system which could not be adequately replaced before summer heat stress develops. Because root replacement is minimal during the summer heat stress period, the amount of roots needed to survive the heat stress period is seriously reduced. Thus, **it is important to maximize the amount of root density and depth as summer heat stress approaches in order to enhance the potential for summer heat stress survival.**

SUMMER ROOT LOSS

Root growth of cool-season turfgrasses is severely restricted during summer heat stress. **This occurs at soil temperatures above 80°F (27°C) when the new root initiation ceases and the maturation or aging of the existing root system is greatly accelerated, especially on creeping bentgrass (*Agrostis stolonifera*) and annual bluegrass (*Poa annua*) putting green turfs.** It is not uncommon for the root system to be shortened to a depth of 1 to 2 inches (25–50 mm), with a sparse root density. It is temperature that is the major factor affecting this root decline. While other biological stresses such as disease may be contributing factors, no amount of pesticide is going to prevent significant root loss from occurring at soil temperatures above 80°F (27°C). It should be noted that cool-season turfgrasses can survive air temperatures well above 80°F (27°C), as long as the soil temperature remains well below 80°F (27°C). This occurs in environments where the air temperatures may be very high during the daylight hours, but there is a substantial radiation cooling of nocturnal temperatures, as occurs in desert environments.

AUTUMN ROOT RECOVERY

As temperatures cool during the late summer-autumn period, some turfgrasses exhibit significant root depth and density recovery from the summer decline, such as is the case with Kentucky bluegrass (*Poa pratensis*), whereas other species may not show significant root replacement until the next spring, such as is the case with creeping bentgrass (*Agrostis stolonifera*), especially on putting greens.

ANNUAL VERSUS PERENNIAL ROOT SYSTEMS

Root death and replacement is a continuing process in certain turfgrasses which can be termed as having a perennial-type root system. Examples include Kentucky bluegrass (*Poa pratensis*) and crested wheatgrass (*Agropyron cristatum*). In contrast, there are perennial turfgrasses which have an annual-type root system. In this case **the root system is fully replaced each year, with a period of significantly deficient root depth and density existing at some time during the growing season.** Examples include creeping bentgrass (*Agrostis stolonifera*), colonial bentgrass (*Agrostis capillaris*), perennial ryegrass (*Lolium perenne*), and rough bluegrass (*Poa trivialis*).

SEEDHEAD DEVELOPMENT EFFECT

Certain grass species have a strong floral development stage during the May period, that also may have a striking effect on rooting. Again, this is related to carbohydrate partitioning. **When the plant is hormonally induced to switch from a vegetative to a developmental stage, then the carbohydrates are allocated to formation of the culm, inflorescence, and eventually grass seeds.** During this period of partitioning to seed development, the root system is deprived of needed carbohydrates and typically dies back.

FEATURE ARTICLE

Compass®: A New Turf Fungicide for 1999

Peter H. Dernoeden

Compass®50WDG (trifloxystrobin) was registered by the U.S. EPA in late 1998 and should be available for sale by the summer of 1999. Compass is a stobilurin-type fungicide and therefore it is in the same class as Heritage® (azoxystrobin). Both Compass and Heritage have similar modes of action and generally target the same diseases (i.e., brown patch, anthracnose, *Helminthosporium* leaf spot, gray leaf spot, summer patch, and *Pythium* blight). Like Heritage, however, Compass only provides about seven days of residual effectiveness on *Pythium* blight, and both fungicides are marginally effective in controlling snow molds.

Both Compass and Heritage interfere with respiration in sensitive fungi. By disrupting the flow of electrons in mitochondria during respiration, the production of the key energy compound known as ATP is reduced. ATP provides energy that drives many biochemical reactions in all living cells. When ATP production becomes limited, many vital cell reactions stop and sensitive fungi cannot grow or reproduce. Indeed, most fungicides do not kill fungi, but act as fungistats that inhabit their ability to grow.

According to Novartis, the company that developed Compass, the chemical has some very unique characteristics, which distinguishes it from other fungicides. Unlike other contacts or penetrants, Compass becomes tightly fixed within the waxy portion of cuticle, and most of the active ingredient remains outside of and embedded in the surface of leaves. Compass can be redistributed by dew or rain on leaves for several days after application. Furthermore, some molecules in the vapor phase can move 2 to 3 inches (50–75 mm) within the turf canopy, thereby redistributing the product to nearby leaves that can reabsorb the fungicide. Hence, adjacent untreated leaves can indirectly pick up the compound. The length of time and the conditions under which Compass can remain in a vapor phase are not clearly understood. A small, but biologically active number of molecules penetrate leaves and move across the mesophyll from the upper to lower leaf surfaces and vice versa. Compass, however, does not move within the transpiration stream. That is, there is no upward or downward movement of the fungicide as in the xylem of plants. In this regard, it is similar to localized penetrants such as Chipco 26GT® (iprodione) and Curalan® (vinclozolin). Evidently, there exists an equilibrium between Compass molecules in the wax and the Compass molecules inside the leaf. As molecules in the leaf are metabolized or otherwise broken down, additional molecules will move into the leaf from the wax to maintain the equilibrium. This dynamic accounts in part for the generally long residual effectiveness (14 to 21 days of disease control depending on rate, disease, and disease pressure) of Compass. Most of the fungicide therefore is lost as a result of mowing. The application of the plant growth regulator Primo (another Novartis product) and possibly other plant growth regulators may help extend the residual effectiveness of Compass by reducing mowing frequency. Most other penetrants, including Banner®, Bayleton®, CL 3336®, Heritage, etc. do move upward in the transpiration stream, and are often described as acropetal (i.e., upward moving) penetrants.

Scientists in both the agro-chemical industry and the academic community are concerned that golf course superintendents will over-apply fungicides from the same chemical class. This has the potential to limit the long term value of Compass and Heritage as well as other fungicides. As with most fungicides, turf pathogens can become insensitive to Compass and Heritage. Compass and Heritage would exhibit cross resistance; that is, if a pathogen is resistant to Compass it will be resistant to Heritage and vice versa. The resistance problem in turf, however, is largely restricted to *Pythium* blight and dollar spot. Neither Compass nor Heritage will control dollar spot and therefore they are not used for managing this disease. However, if dollar spot is active at the time Compass or Heritage are to be applied, the aforementioned materials must be tank-mixed with a fungicide with activity against dollar spot. In *Pythium* control programs, Compass (0.15 oz/1,000 ft^2; 4.3 g/93 m^2) performs better when tank-mixed with Subdue MAXX® (0.5 fl. oz/1,000 ft^2; 14.5 mL/93 m^2). Regardless, it is generally best to alternate fungicides with different modes of action. Tank-mixing fungicides with different modes of action also delays the potential for resistance and many combinations tend to provide a broader spectrum of diseases controlled as well as improved residual effectiveness. Other good reasons to alternate fungicides with different modes of action would include avoiding disease resurgence and reduced residual effectiveness due to enhanced microbial degradation.

While Compass has curative activity, it should be used at higher rates once disease symptoms appear. Compass therefore is better utilized in preventive programs. The label use rates range from 0.10 to 0.25 oz of product/ 1,000 ft^2 (2.9–7.2 g/93 m^2). Brown patch (*Rhizoctonia* spp.), anthracnose (*Colletotrichum graminicola*), and red

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FEATURE ARTICLE

Lontrel Turf and Ornamental: Another New Herbicide for 1999

Fred Yelverton

As mentioned in the two previous issues of Turfax, two new herbicides (Drive and Lontrel) and one new plant growth regulator (Proxy) either will be, or are currently available for use. In this issue, we will discuss Lontrel Turf and Ornamental from Dow Agrosciences. It is projected that this product be available for the 3rd quarter of 1999.

Lontrel Turf and Ornamental contains 3 lbs/gal (120 g/L) of clopyralid. Clopyralid has been registered for use in turfgrasses for several years and is available in a prepackage mixture with triclopyr and sold as Confront. Most turfgrass managers who have used Confront know that it is very effective on leguminous plants such as clover, vetch, lespedeza, etc. The active ingredient in Confront that is providing control of these leguminous weeds is clopyralid. Therefore, Lontrel Turf and Ornamental will be an outstanding product for control of legumes in turf and certain ornamentals.

Lontrel is a postemergence herbicide that will carry a *Caution* signal word. Another favorable attribute of Lontrel will be that most turfgrass species exhibit good tolerance to this herbicide. The tolerant turfgrass species (cannot be used on putting greens or tees) to Lontrel are as follows:

Tolerant Cool-Season Turfgrasses	Tolerant Warm-Season Turfgrasses
bentgrasses	bermudagrasses
Kentucky bluegrass	bahiagrass
creeping red and Chewings fescue	buffalograss
sheep fescue	centipedegrass
tall fescue	zoysiagrasses
perennial ryegrass	St. Augustinegrass

Lontrel should be applied to small, actively growing weeds in a minimum of 20 gallons of water per acre (185 L/ha). The use rate ranges from 1/4 pt/a to 1-1/3 pt/a. Surfactants are usually not necessary. The table on the right contains a list of weeds on the label that claim to be controlled at specific Lontrel rates.

As with any herbicide, there will be precautions for use. Lontrel cannot be used on putting greens and tees. This product should not be applied to exposed roots of certain trees and shrubs (legumes such as acacia, locuts, mimosa, redbud, or mesquite) or *Tilia* spp. Also, turfgrass managers should not reseed within 3 weeks of application. Clippings from treated turf should not be used for mulching, and compost containing grass clippings from treated turf should not be used in the growing season of application. In addition, the maximum use rate in California is 2/3 pt/a per growing season.

Another advantage of Lontrel is that it can be used for weed control in various ornamentals. The following is a list of ornamentals that can be sprayed over-the-top or as a directed spray for broadleaf weed control:

Ornamentals that an Overtop Spray can be used:

fir (balsam, Douglas, fraser, grand, noble), pine (lodgepole, ponderosa, Scotch, white), spruce (Norway, white, Colorado [blue]), yew, *reseum elegans* rhododendron, mugo pine, blue star juniper, shore juniper, littleleaf boxwood, hino-crimson azalea, and arborvitae (American & nigra-dark)

Ornamentals that a Directed Spray can be used:

flowering dogwood, red maple, red oak, willow, oak, American sycamore, and cinquefoil

As with any new herbicide, Lontrel Turf and Ornamental should be tested on a small area before widespread application. It appears the biggest advantages of Lontrel will be turfgrass tolerance and superior control of leguminous weeds.

1/4 to 1/3 pt/a	1/3 to 1/2 pt/a	1/2 pt/a	1-1/3 pt/a**
black medic	red clover	Jerusalem artichoke	buffalo bur
curly dock	hop clover	cocklebur	hairy buttercup
broadleaf dock	white clover	coffeeweed	Russian knapweed
galinsoga	sweet clover	narrowleaf hawksbeard	ladysthumb
goldenrod		jimsonweed	broadleaf plantain
stinking mayweed		marshelder	perennial sowthistle
nightshade (eastern, black, cutleaf, and hairy)		musk thistle	
pineappleweed		speedwells	
		yellow starthistle	
		sunflower	
		common vetch	

FEATURE ARTICLE

Another Insecticide Bites the Dust

Daniel A. Potter

This fall will mark the passing of another long-standing turf insecticide. Bayer Corporation has requested voluntary cancellation of Oftanol 2, and all products containing isofenphos, its active ingredient. Registered in 1983, Oftanol was among the mainstays for soil insect control on both home lawns and golf courses. However, sales of Oftanol have declined in recent years, especially since the registration of Merit and Mach 2 for grub control, and other new insecticides for mole crickets. When the EPA added more data requirements for re-registration of organophosphates under the 1996 Food Quality Protection Act, Bayer decided that these costs could not be recovered during the projected sales life of the product.

Although the federal registration of Oftanol 2 will be terminated this autumn, state registrations will remain active, and inventories of the product can be sold and used until the supply is exhausted.

The loss of Oftanol continues the trend of cancellations of other organophosphate turf insecticides for similar reasons. Within just a few years, we've lost Crusade (fonophos), Mocap (ethoprop), Triumph (isazophos), diazinon for golf course use, and other products. Dylox and Turcam, a carbamate, are the only relatively fast-acting soil insecticides still available for curative control of large grubs on golf courses.

Hopefully, new generations of advanced soil insecticides will be developed in time to fill the void. One such product that looks especially promising is thiomethoxam, a novel compound from Novartis. It combines the residual, preventive capabilities of Merit and Mach 2 with good activity against mid- to large-size grubs. Thiomethoxam may be on the market as early as next year. We currently are testing other novel, reduced-risk compounds for turf insect control.

A Mutation Problem?

James B Beard

For years the appearance of off-type strains in both Tifdwarf and Tifgreen hybrid bermudagrass (*Cynodon dactylon* x *C. transvaalensis*) has been attributed by many to mutations. While it is true that these two cultivars have a higher tendency for mutations to occur than many bermudagrass cultivars, it is still a very rare occurrence.

When I arrived at Texas A&M University in 1975 there was a large experimental putting green, half of which was established to Tifdwarf and half to Tifgreen. It was at least 10 years old at that time and I subsequently continued to maintain it for another 22 years. The two hybrid bermudagrass cultivars were grown immediately adjacent to one another, without a bare alleyway separation. During the 32+ years, there were four different investigators in charge of the TAMU Turfgrass Research Field Plots, with a great diversity of experiments ranging from fertility practices to winter overseeding to pesticide studies being conducted on that green. **In spite of this diversity of uses on this putting green over a period of 32+ years, the appearance of off-type bermudagrass strains never occurred in either hybrid bermudagrass cultivar!**

Comments. These observations suggest that if one obtains uniform, true-to-type hybrid bermudagrass planting material and plants onto a site that is completely free of off-type bermudagrass sprigs, then the chance of off-type strain development is very low. In contrast, the off-type strain occurrence on many new putting greens is developing in less than 5 years and is quite extensive across the putting greens on a number of golf courses. In most cases this is probably the result of either (1) **Contamination of the planting material with off-type,** (Superior bermudagrass sprig producers walk their production fields weekly and immediately spot-kill any off-type plants that appear), or (2) **Failure to properly eradicate any potential contaminates in the plantbed prior to establishment of the new bermudagrass cultivar.** One should note that even repeat applications of glyphosate (Roundup Pro®) do not give eradication of bermudagrass. Rather it is important to properly prepare the site and treat with methyl bromide to minimize the chance of contamination from existing off-types.

The Occurrence and Management of Localized Dry Spots

Peter H. Dernoeden

Localized dry spots are common on high-sand content greens or older style mineral soil (i.e., push-up) greens that have been aggressively topdressed for several years with a mix containing more than 80% sand by volume. They normally develop in new golf course greens within 6 months to 3 years of seeding. While they tend to decline in number and severity over time, some dry spots can be a persistent problem for indefinite periods. These dry spots develop with the advent of high temperatures and dry periods from late spring to autumn. They often disappear during extended overcast and rainy periods. Localized dry spots appear as solid patches of wilted or dried-out turf. Their appearance is sometimes preceded by fairy ring development or simply by the presence of numerous mushrooms. Patches can be circular and range from a few inches (6 to 8 cm) to several feet (0.5 to 1.0 m) in diameter, or they may appear as large serpentine or irregularly-shaped areas of wilted or dead turf. Soil within the patches remains bone dry despite frequent irrigation. Water will penetrate the thatch, but not the thatch-soil interface, and will usually run-off dry spot areas. Plants within affected areas develop a blue or purplish color that is indicative of wilt, and eventually they die as a result of drought stress.

The cause of localized dry spots has been attributed to the decomposition activities of unidentified basidiomycetous (mushroom) fungi in the same group that cause fairy rings and other microorganisms in soil. These microorganisms cannot be isolated from samples obtained from the hydrophobic (water repellent) soil. It is believed that water repellency is caused by the breakdown of older fungal mycelium and other organic matter, which releases substances that provide a coating of organic material around individual sand particles. This organic coating, however, also may result from the breakdown of plant tissues such as roots, shoots, and stems or organic soil amendments such as peat moss or composts. Individually coated sand particles pack together, thus rendering the soil impervious to water infiltration. The water repellent, i.e., hydrophobic condition is normally restricted to the upper few inches (3 to 6 cm) of soil. Removal of thatch alone will not significantly improve water infiltration.

Management. Verti-draining, core aerification, quadratine aeration, water injection aeration, or hand pitch-forking in combination with frequent applications of a wetting agent will help to alleviate this condition. Water injection aeration is least destructive and quite effective, however, it does not cure the condition. Keeping turf alive in localized dry spots may require numerous daily syringes and treatments of wetting agents and/or water injection aeration during dry summer periods. Where localized dry spot is chronic, the application of wetting agents should begin several weeks in advance of the time they normally appear. Pretreatment with wetting agents in conjunction with some form of aeration is the preferred preventive control strategy for this problem. Isolated spots can be individually treated by frequent probing with a water-fork or a tree deep-root feeder that injects water. Fungicides have no known impact on the incidence, severity, or control of localized dry spots.

High-Density Cultivars for Putting Greens Have Different Nitrogen Requirements

A number of golf course superintendents have expressed an opinion that the new high-density cultivars of hybrid bermudagrass (*Cynodon dactylon* x *C. transvaalensis*) for closely mowed putting greens are very similar. This comment is ill conceived! While the five cultivars released to date have not been fully characterized, there is now enough information available to know there are distinct differences among a number of them.

First, **it should be recognized that some cultivars are vertical-dwarf hybrid bermudagrasses, while others are full-dwarf hybrid bermudagrasses.** The importance of this growth habit differential was discussed in a previous Turfax article.

More recently, comparative experimental plot assessments have revealed distinct differences in the minimum nitrogen fertility requirement to sustain a green color. It is becoming evident that the range is quite great being from 6 to 18 pounds of nitrogen per 1,000 ft^2 (3 to 9 kg N/100 m^2) per year. **Cultivars requiring only 0.5 lb N/1,000 ft^2 (0.25 kg N/100 m^2) per growing month (gm) range are Champion, Mini Verde, and MS Supreme, which are vertical dwarfs. At the other extreme is Floradwarf which requires 1.5 lb N/1,000 ft^2/gm (0.75 kg N/100 m^2/gm); while TifEagle is intermediate at 1.0 to 1.2 lb N/1,000 ft^2/gm (0.5–0.6 kg N/100 m^2/gm).** In the case of Floradwarf and TifEagle, the use of nitrogen fertility rates lower than the rates listed above can result in a distinct loss of green color. Whether the other three cultivars would tolerate nitrogen rates below 0.5 lb N/1,000 ft^2/gm has yet to be assessed.

Cultivars that can maintain an acceptable green color at lower nitrogen rates, as well as sustain a high shoot density at very-close mowing heights, also have the beneficial attributes of (1) a slower vertical leaf extension rate which means a faster, day-long putting green speed and (2) a reduced tendency to form excessive canopy biomass which requires an increased frequency of vertical cutting. In this regard, **by far the best control of excess canopy biomass accumulation with these high-density cultivars is extraordinarily close mowing at 1/8 to 1/10 inch (3.2–2.5 mm).**

Golf Course Construction—Beware

In the past year **there have been a number of highly publicized incidences where severe soil erosion has occurred at golf course construction sites** that resulted in soil movement into trout streams and/or lakes. These incidences are unfortunate and every effort must be made to avoid similar occurrences in the future. If appropriate preventive measures are not taken, the whole golf industry may suffer.

This environmental issue resulted in a key law being passed in Japan some years ago. Specifically, **it requires that only three holes on a golf course can be constructed at one time, and no additional soil disturbance is allowed until the three holes under construction are fully stabilized with turf.** As a result many golf course fairways, tees, and roughs are sodded, especially since zoysiagrass (*Zoysia* spp.) commonly is used and has a very slow establishment rate. Consequently, the cost for construction of golf courses in Japan has increased greatly, which in turn has substantially increased the cost to those playing golf and resulted in greater exclusivity. Under this law, the construction and normal grow-in by vegetatively sprigged zoysiagrass would take up to 12 years for an 18-hole golf course, whereas by sodding with zoysiagrass an 18-hole golf course can be completed in 4 to 6 years.

Comments: It behooves golf course owners, architects, and contractors in North America to do everything possible to protect against serious off-site soil erosion, particularly soil movement into streams and rivers, as a result of intense rainfall events. The cost of such preventive measures should not be an issue! Otherwise the whole golf industry is adversely affected.

RESEARCH SUMMARY

The Response of Annual Bluegrass and Creeping Bentgrass to Five Levels of Iron

The color and growth response of 3 Penncross creeping bentgrass (*Agrostis stolonifera*) parents and 6 genotypes of flowering and nonflowering annual bluegrass (*Poa annua*) to 5 iron treatments were evaluated in a greenhouse study involving 4 replications. The nitrogen treatments in the first experiment consisted of 0, 2, 4, and 6 mg per liter of iron and in the second experiment 0, 2, 4, 6, and 8 mg per liter of iron. **The results revealed that creeping bentgrass and annual bluegrass responded differently to the rates of iron applied.** Both shoot growth and color of the creeping bentgrasses increased linearly with increased iron levels. The shoot growth response of the annual bluegrasses to increasing iron applications was small, while the color changes were more apparent. In other words, **annual bluegrass exhibited a greater color response, while creeping bentgrass exhibited a greater shoot growth response.** Actually the shoot growth of annual bluegrass was reduced at the highest iron rate evaluated. The root growth responses to increasing iron levels were similar for both species, with both increasing linearly. Also the vegetative and flowering types of annual bluegrass responded similarly to the iron treatments. **The iron contents of the leaf tissue were similar for both creeping bentgrass and annual bluegrass.** Thus, these data suggest that using differential iron applications rates to enhance the competitiveness of annual bluegrass relative to the creeping bentgrass may not prove successful. **Source: Annual bluegrass and creeping bentgrass response to varying levels of iron. 1998. By X. Xu and C.F. Mancino. Annual Research Report, The Pennsylvania State University Center for Turfgrass Research, pp. 50–53.**

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A Promising Topdressing Approach for High-Density Cultivars

James B Beard

A concern in the culture of the new high-density cultivars of both creeping bentgrass (*Agrostis stolonifera*) and dwarf hybrid bermudagrass (*Cynodon dactylon* x *C. transvaalensis*) under very-close mowing heights of 1/8 inch (3.2 mm) or less on putting greens **has been the difficulty in getting topdressing material down into and through the turfgrass canopy.** Now a few superintendents report a new approach that shows promise. Specifically, it involves **topdressing followed by a light/shallow vertical cutting which greatly accentuates the movement of sand topdressing material into the turf canopy.** The higher the topdressing rate applied, the deeper the vertical cutting that should be considered. It also should be indicated that **using sand particles in the lower two-thirds of the USGA particle size distribution range is helpful.**

Comments: When using vertical cutting in combination with topdressing, one should be aware of the potential for added abrasive effects on the grass leaves which could accelerate the occurrence of certain diseases, as the wounds serve as invasion sites for causal pathogens. **For this reason, scheduling the vertical cutting-topdressing combination for periods when disease activity is minimal may prove advisable.** Please note that this technique is in its early phase of development and has shown promise, but it probably will require further use under a diversity of situations to completely understand the proper application and long-term success as a part of a routine cultural program. If you are interested in testing the approach, try it first on a nursery green or the back portion of a large regular putting green.

ASK DR. BEARD

Q *Are there preferred times to schedule foliar feeding applications?*

A It should be noted that foliar feeding involves the application of a small amount of nutrients in a quantity of water such that there is no run-off from the leaves. This maximizes uptake of the nutrients primarily through the stomatal openings in the leaves and stems. Since a majority of the foliar applied nutrients are taken up through the stomatal, it is best to make the application when the stomata are open. The main prerequisite for stomatal opening is light. The stomata are open only during the daylight hours. A second controlling factor is the potential for internal plant water stress. When the evapotranspiration rate exceeds the water uptake rate from the roots, a negative internal water stress develops, with one of the first plant responses being closure of the stomata. It is not uncommon for stomatal closure to occur daily at midday during periods of peak evapotranspiration. Thus, it is advisable to avoid foliar feeding applications during this midday period when the potential for stomatal closure is great, especially under conditions of peak evapotranspiration and limited root growth.

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Compass®...

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thread (*Laetisaria fuciformis*) are effectively controlled for 14 or more days at 0.10 to 0.15 oz/1,000 ft^2; whereas, the 0.15 to 0.25 oz/1,000 ft^2 range is preferred for gray leaf spot (*Pyricularia grisea*) management. The higher rate range of 0.20 to 0.25/1,000 ft^2 is recommended for controlling summer patch (*Magnaporthe poae*) and *Pythium* blight. Rust (*Puccinia* spp.) and *Helminthosporium* leaf spot also are controlled, but Compass appears to be less effective against snow molds (*Microdochium nivale* and *Typhula* spp.)

Reference

Compass Technical Bulletin. 1999. Novartis Crop Protection, Inc., Turf & Ornamental Products, Greensboro, NC 27419.