

Late-season fertilization of bermudagrass

Despite years of advice to the contrary, late-season fertilization may be beneficial for some bermudagrass cultivars.

R.E. Schmidt, Ph.D.

A primary concern in producing bermudagrass (*Cynodon dactylon*) turf is whether the turf will survive low temperatures during dormancy. For the past 25 years, turfgrass experts have differed over the concept of proper bermudagrass fertilization. Textbooks and turfgrass researchers have often recommended cultural practices that actually decreased turfgrass survival at low temperatures.

Over the past several decades, turfgrass breeders have selected or developed bermudagrass cultivars that tolerate relatively low soil temperatures. Cold tolerance is important where bermudagrass faces freezing temperatures, but cold tolerance in bermudagrass has expanded the area where bermudagrass is grown. Because bermudagrass is now grown in colder climates, cultural aspects continue to be important in ensuring bermudagrass survival during dormancy.

Interactions between various cultural practices are complex and difficult to associate with bermudagrass survival in dormancy. For example, in one study, applying the herbicide DCPA to Vamont bermudagrass increased low-temperature damage, but applying the same herbicide to Midiron bermudagrass, a cultivar more tolerant of low temperatures, did not (1).

Fertility and bermudagrass dormancy

Keeping in mind that many environmental and genetic interactions influence winter hardiness, I discuss here studies of the impact of fertility on bermudagrass survival during dormancy. A 1979 study (2) showed that mortality of Tifgreen bermudagrass was greater when dormancy following freezing temperatures was longer. Therefore, it appears that factors that shorten the dormancy period after freezing will result in better winter survival of bermudagrass.



Vamont bermudagrass research plots at the Turfgrass Research Center, Virginia Tech, Blacksburg, Va., are shown in November 1989 after they had been fertilized late in the season with nitrogen and iron.

Photos courtesy of Richard Schmidt

Enhanced color

Several researchers have reported that late-season fertilization may extend photosynthetic activity of bermudagrass in the fall and stimulate it early in the spring. Turfgrass managers have been reluctant to fertilize bermudagrass late in the season because textbooks have stated that excessive or late-season nitrogen fertilization will stimulate succulent growth and inhibit low-temperature hardiness.

However, studies conducted at Mississippi State University (5-7) and at the University of Arkansas (11) have shown that fertilizing with soluble nitrogen late in the growing season enhanced fall and spring color of bermudagrass without directly increasing the potential for winterkill. Slow-release nitrogen fertilizer sources provided little fall or spring response, however. In Southern California, nitrogen fertilizer was important in extending color of several seeded bermudagrass cultivars in late fall and early winter (3).

Heavy late-season nitrogen fertilization of 48 pounds/acre/month from June through September has been shown to enhance fall color of Midiron bermudagrass (17), and late-season nitrogen fertilization enhanced both spring and fall color of Tifgreen bermudagrass (12).

In the early 1970s, several workers (4,8,10) reported that high rates of nitrogen (approximately 3 to 4 pounds nitrogen/1,000 square feet incrementally applied in September and October) would enhance

KEY points

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Surviving cold winter temperatures

is a challenge for bermudagrass.

Late-season fertilization has been thought to be harmful to bermudagrass.

Studies over the last 30 years

have shown that late-season fertilization with nitrogen and sometimes iron may help bermudagrass survive cold winter temperatures.

RESEARCH

recovery from dormancy when applied with high amounts of potassium. More recently, Goatley (5) used tissue analysis to show a linear increase of nitrogen, phosphorus and potassium concentration as nitrogen fertilization levels increased. This may partly explain why no visual winterkill damage was seen with late-season nitrogen fertilization.

No increase in winter injury

In Virginia, researchers (13) reported that both light and heavy traffic imposed on bermudagrass in autumn reduced growth after dormancy as measured the following June. However, when high nitrogen fertilization (87.4 pounds/acre/month in August and September) stimulated foliar development, the treatment helped offset the effects of traffic better than a treatment in which half this amount of nitrogen was applied. These data indicate that relatively heavy applications of nitrogen in late summer or early fall extended bermudagrass fall color and did not increase winter injury.

To illustrate further that delaying bermudagrass dormancy in autumn did not contribute to winter injury, clear plastic covers were installed over the bermudagrass in early October (before dormancy) and removed in mid-March (14). Dormant plugs were sampled from these plots in March, frozen to 27 F and subsequently grown in a greenhouse. Measurements taken 10 and 30 days after freezing showed that clipping yields from covered plots were greater than those from plots that were not covered.

Results of several other experiments con-

ducted using laboratory cold treatments gave evidence that heavy late-season nitrogen fertilization did not directly increase winter injury. Field-grown Midiron bermudagrass was subjected to different traffic and nitrogen regimes and then sampled when dormant, frozen to 27 F in late March and grown in a greenhouse. Samples showed that traffic reduced clipping yields, but clipping yields increased when the turf was fertilized with nitrogen (117 to 198 pounds nitrogen/acre) from July to September (13). In another study (12), neither foliage nor root mass was reduced when Tifgreen bermudagrass was treated with 120 to 240 pounds nitrogen/acre applied in September, sampled in the dormant stage, laboratory frozen and subsequently grown in a greenhouse.

Although Goatley (5) gave evidence that late-season nitrogen fertilization enhances fall and spring growth and does not directly increase the potential for winter low-temperature injury of bermudagrass, he indicated that other related factors should be considered. When weed invasion or disease susceptibility have been associated with applications of nitrogen fertilizer at high rates (more than 4 pounds nitrogen/1,000 square feet applied within 30 days of dormancy), withholding late-season nitrogen applications may be prudent. It may be possible to extend fall bermudagrass activity by using less nitrogen fertilization and adding foliar iron applications.

Iron fertilization

In Mississippi, iron applied at 4 pounds/acre in late-season was sufficient to achieve a desir-

able fall bermudagrass color (5). However, the color response did not carry over into the spring following dormancy. In Southern California, fall color retention of seeded bermudagrasses was enhanced with high iron treatment of up to 4 ounces iron/1,000 square feet/month, but results varied with the cultivar (3). In Virginia, iron applied in late August and September also improved bermudagrass color through late October. This influence was detected the following summer (12,17). When dormant Tifgreen bermudagrass samples were subjected to 23 F in January and subsequently grown in the greenhouse, sprigs that had received late-season iron treatments had enhanced root mass (12). In addition, dormant sprigs sampled from these iron-treated plots and planted in the field in March had significantly more coverage in July than sprigs from the control plots.

Applications of iron made from July to mid-October in Virginia did not influence summer turfgrass color of Midiron bermudagrass (17). However, fall and spring greenness and turf quality were enhanced when iron was applied biweekly 30 to 40 days before dormancy at 0.5 pound/acre. It was concluded that foliar-applied iron in conjunction with moderate summer nitrogen fertilization totaling 2 to 4 pounds nitrogen/1,000 square feet can extend bermudagrass quality during fall and enhance recovery after dormancy the following spring.

Iron availability

The various responses of iron fertilization reported by California, Mississippi and Virginia researchers may be explained by understanding how grass plants absorb iron from the rhizosphere. Although iron in a soil may be sufficient, it may be sparingly soluble under certain environmental conditions, and uptake by the plant would be reduced. The iron-acquisition systems of grasses differ from those of other plants (9). Grasses release natural chelators called *mugineic acids* (phytosiderophores) from the roots, which enable the grass to take up sparingly soluble iron and transport it to other parts of the plant. If conditions prevent the release of mugineic acid, foliar applications of iron would produce positive results.

It seems that mugineic acids are not released when bermudagrass is exposed to the cool soils of autumn and spring in Virginia and of autumn in Mississippi. Therefore, application of iron improved turfgrass quality during these periods in these areas. In the warmer climate of Southern California, most



Tifgreen bermudagrass research plots at the Virginia Tech Turfgrass Research Center, Blacksburg, Va., were photographed in the fall 1989 after receiving late-season fertilization with iron and nitrogen. Dave Chalmers, Ph.D. (pictured), assisted the author with the research.

of the seeded bermudagrasses were able to release sufficient mugineic acid in the fall so that iron fertilization had little impact. The exception was the cultivar Princess, which apparently was unable to release sufficient phytosiderophores during this time of the year and responded positively to iron fertilization.

Impact of low temperatures

In studies concerning the impact of chilling fall temperatures on Tifgreen bermudagrass, iron fertilization produced a darker green color than the control after the grass was exposed for 72 hours to chilling temperatures (50/45 F day/night temperatures) (15). On a per-unit chlorophyll basis, iron-treated bermudagrass had higher photosynthetic and respiration rates before and during chilling and during recovery from chilling.

Midiron and Tifgreen should be classified as chill-tolerant and chill-sensitive bermudagrass cultivars, respectively, based on carbon exchange during and after exposure to chilling temperatures (16). Accumulation of photoassimilate (sugars) in the chloroplast may inhibit the recovery of photosynthetic activity in chill-sensitive bermudagrass following exposure to chilling temperatures. From these data, it may be postulated that applied iron may help maintain physiological activity by enhancing carbohydrate translocation (partitioning) during chilling temperatures and improve desirable turf quality of bermudagrass exposed to chilling temperatures (16).

Iron fertilization maintained the aesthetic quality of both Midiron and Tifgreen after the chilling period and stimulated recovery of daytime and nighttime carbon exchange. Therefore, foliar application of iron should help maintain desirable turf quality in bermudagrass cultivars exposed to chilling temperatures.

Conclusions

- Late-season application of soluble nitrogen fertilizer at rates of up to 4 pounds nitrogen/1,000 square feet applied incrementally 10 to 30 days before dormancy will not directly increase bermudagrass injury caused by cold temperatures in winter.
- Late-season application of soluble nitrogen fertilizer at the above rates will extend activity of bermudagrass in the autumn and stimulate growth after dormancy in the spring.
- Adequate soil potassium (medium to high available potassium as indicated by soil tests) should be available in late season to ensure protection against injury from cold temper-



Bermudagrass fairways at Macgregor Downs GC in Cary, N.C., fertilized late in the season with nitrogen and iron, maintained good green color in late November 1988 after several frosts. Then-superintendent Jeff Granger is pictured.

atures in winter.

- In most cases, late-season application of iron with split applications totaling 3 to 7 pounds of iron/acre applied 10 to 30 days before dormancy will extend bermudagrass metabolic activity in autumn and enhance recovery after dormancy the following spring.
- Late-season combinations of nitrogen and iron at the rates suggested above appear to enhance metabolic activity of bermudagrass before and after dormancy.

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R.E. Schmidt, Ph.D. (rschmidt@vt.edu) is professor emeritus at Virginia Tech in Blacksburg.