Help Bentgrass Beat the Heat

Bentgrass' Tolerance of Summer Heat Stress Depends On Your Year-Round Maintenance Practices

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Bentgrass is not well-adapted to high summer temperatures. However, you can help bentgrass through this stressful time by using fans to increase transpiration and cool the turf.

Creeping bentgrass prefers the cool, moist European climate from which it originated. How, then, can you maintain creeping bentgrass through the scorching mid-summer heat common to the Transition Zone and Upper South? Actually, the challenge is not keeping bentgrass alive in temperatures above 100øF; it's keeping it alive at these temperatures while you mow it at 1/8 inch and subject it to constant traffic. It isn't natural, it isn't easy, and it requires special knowledge and talent.

Creeping bentgrass is a cool-season grass that prefers air temperatures between 60 and 75øF and soil temperatures between 50 and 65øF. Nighttime temperatures are particularly important. Even if daytime highs are in the 90s, nights in the low- to mid-60s significantly ease heat stress. In the Transition Zone and Upper South, however, mid-summer temperatures commonly exceed 90øF during the day and 70øF at night.

Research we've conducted at Kansas State University shows that bentgrass-root-zone temperature plays an important role in turf performance regardless of air temperature. If the root-zone temperature is 100øF and air temperature is 68øF, shoot quality will decline rapidly. Conversely, when we exposed shoots to 100øF, it did not affect shoot quality when the root-zone temperature stayed at 68øF (see photo, page G 16). Roots play an important role in regulating shoot response to high temperatures. This information suggests that the development of some type of refrigeration for root zones in greens could help maintain summer turfgrass quality.

Nursing Bentgrass Through the Heat

Bentgrass plants stay cool by evaporating water through microscopic pores called stomata, which are present on the upper and lower surfaces of leaf blades. This evaporation process is called transpiration. The plant experiences a response not unlike the one you might feel immediately after stepping out of a pool in mid-summer. You are cooler because water is evaporating from the surface of your skin. For this cooling process to work effectively (in plants), a gradient must exist between the layer of humidity surrounding the leaf (the boundary layer) and the atmosphere. Of course, the relative humidity at the leaf surface is almost always 100 percent. Atmospheric relative humidity, on the other hand, varies greatly. Lower atmospheric relative humidity results in a "steeper" gradient, and more water evaporates to cool the plant more effectively. This explains why you can grow bentgrass in Arizona, where mid-summer humidity is low, but not in southern Florida where the relative humidity is always high. Bentgrass growing in the humid South is unable to transpire water effectively. This results in heat buildup within the plants' tissues and leads to heat stress.

Creeping bentgrass usually doesn't exhibit symptoms of heat stress overnight. Indirect high-temperature stress appears days or weeks after exposure to temperatures above the optimum range. Our research results provide clues to understanding how a prolonged period of exposure to high temperatures results in bentgrass decline.

Photosynthesis is the process by which plants use sunlight, carbon dioxide and water to produce food (carbohydrates). Bentgrass prefers cooler temperatures because it photosynthesizes more efficiently than during warmer temperatures. In other words, photosynthesis operates at an optimum level when bentgrass is growing within its preferred temperature range and becomes less efficient as temperatures increase above the desired range.

Conversely, the process whereby the plant expends energy-respiration-increases with temperature. Food consumption is, therefore, much faster in mid-summer than it is in spring or fall. When food consumption consistently outweighs food production, as in summer, plant health falters. The plant is literally starving. This probably is the primary contributor to bentgrass decline (see graph, at right).

You cannot prevent high summer temperatures, but you can develop a plan to reduce the starvation of bentgrass during the mid-summer heat. The first tactic is to manipulate the plant's environment. You can accomplish this by using proper greens-construction methods, encouraging air movement and syringing.

* Construct proper greens. You'll first notice heat-stressed bentgrass on push-up greens constructed with heavy soil. These soils often are compacted, poorly drained and generally unfavorable for root growth. Our research demonstrates that a bentgrass plant whose roots are growing under saturated conditions is more susceptible to heat stress than one growing in well-drained soil. Superintendents often blame turf decline under these conditions on root-infecting diseases or other pathogens. Although pathogens may be present, they usually appear

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after the primary stress (poor soil condition) has increased the plant's susceptibility to infection. Superintendents usually apply fungicides when decline symptoms appear, but until they remedy the primary problem, these symptoms may appear year after year.

* Increase air movement. Wind helps increase the humidity gradient between the leaf and atmosphere so that water more readily transpires through stomata and cools the plant. Therefore, a bentgrass green surrounded by trees or situated in a low area enclosed by berms is prone to heat stress due to a lack of air movement. You can enhance air movement by removing vegetation. Unfortunately, convincing members to remove trees can be like pulling teeth. Thus, superintendents in the Transition Zone and the South routinely use fans to encourage air movement, improve transpiration and cool the turf. Fans are usually permanent fixtures, which you can inconspicuously locate in vegetation surrounding your green.

* Syringe. A plant suffering from heat stress often will close its stomata even when adequate soil moisture is available. When this happens, it is unable to cool itself. A light application of water to the leaf surface-syringing-will provide evaporative cooling if the atmospheric relative humidity is low enough to for significant evaporation to occur. You should recognize the difference between syringing and irrigation, however. Syringing refers to wetting the leaf surface only. Bentgrass with a shallow root system could require midday watering to nurse it through the heat of the day. This is merely frequent irrigation, however, not syringing.

Favoring Bentgrass With Good Cultural Practices

You also should give special attention to cultural practices on bentgrass greens to ensure greater survivability during summer heat. Cultural practices you perform in the spring and fall, when bentgrass is most efficient at photosynthesis, will dictate how that turf performs in the summer.

You should encourage bentgrass to store food before high summer temperatures arrive. In a sense, summer is bentgrass' resting period. Bentgrass plants store any excess food they produce during cool weather for later use. Maximizing spring food storage reduces the likelihood of mid-summer starvation. To accomplish this, mow at the highest acceptable height, maintain a balanced fertility program, irrigate to encourage plant-stress resistance and select heat-tolerant bentgrass cultivars.

* **Mowing.** Ultra-low mowing probably has lead to more problems with summer bentgrass decline than any other cultural factor over the past 10 years. Maximizing leaf area encourages a positive energy balance in the plant. With

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more leaf area present, the plant's ability to produce food will be greater. Our research shows that even a slight increase in mowing height, say from 4/32 inch to 5/32 inch, can make a large difference in summer turf quality (see bottom graph, page G 13). The additional leaf area seems to provide the food-processing machinery necessary to maintain a positive carbohydrate balance and avoid summer starvation.

Although grass plants may tolerate a lower mowing height during cooler temperatures in spring and fall, it only makes sense to mow higher during these periods to maximize carbohydrate storage. As we just discussed, bentgrass plants tend to expend surplus carbohydrates during summer months.

Some advisors suggest that you can reduce bentgrass mowing heights during summer months because the plant is producing little food anyway and it will produce no new roots. However, our results indicate that some photosynthesis and food production occurs even during periods of high temperatures.

AFTER A GREAT DAY AT RIVER FALLS GOLF CLUB, the MGCSA Scholarship Committee met and put plans together for the June 21 Scholarship Scramble at Rich Spring Golf Course. Clockwise from left are John Queensland, Cedar River Golf Club; Jeff Johnson, The Minikahda Club; Steve Garske, Par Aide Products Co., and Jon Almquist, MTI Distributing Co.

Furthermore, carbohydrates are necessary not just for growth but also for maintenance of tissues, including roots. Mowing at the highest acceptable height in midsummer encourages survival of existing roots.

* **Fertilizing.** The bentgrass plant that has all essential nutrients available to it in adequate quantities is better prepared for heat stress than one that is malnourished. Nitrogen is the staple in the program, so you should apply it at levels that maintain adequate density and growth. Low-annual-nitrogen strategies for the sake of green speed are not conducive to good plant health and summer-heat tolerance. Likewise, excessively high nitrogen levels produce a succulent plant that is less resistant to high temperatures. You should assess other soil-chemical factors such as pH, phosphorus and potassium with regular soil tests. Potassium, in particular, may help increase heat tolerance. Superintendents commonly apply potassium at levels equivalent to nitrogen on sand-based greens.

* Irrigating. Superintendents have a tendency to overwater greens. Amount and frequency of irrigation should depend on weather conditions, soil type and rooting depth. You should wet soil to the depth of the root system with each irrigation. Then allow it to dry nearly to the point where drought symptoms first appear. Of course, if roots have deteriorated to a depth of 1 inch in mid-summer, the turf may need two or more irrigations per day according to these guidelines. Thus, if you water your greens on a set schedule, applying the same amount of water every day without considering environmental conditions or rooting depth, you should re-evaluate your program.

* **Selecting cultivars.** If you are re-establishing greens, consider the new bentgrass cultivars that demonstrate good heat tolerance. Cultivars that have performed well in our heat-tolerance tests (in Manhattan, Kan.) include Crenshaw, L-93, Penn A-4 and SR-1020. Consult National Turfgrass Evaluation Program trials for results from areas near you, and pay special attention to performance during the summer months. Just remember that selecting a heat-tolerant cultivar will not solve all your problems with bentgrass decline. You also must consider environmental conditions, soil type and cultural practices.

To maintain bentgrass greens through high summer temperatures, you must understand the causes of the heat stress and take corrective action. Focus on modifying the plant's environment and on year-round cultural practices to help your bentgrass will remain stress-free.

Practices That Encourage Heat Tolerance In Bentgrass

1. Install fans to help cool greens with restricted air movement.
2. Syringe greens to provide evaporative cooling to plants under heat stress.
3. Mow at the highest acceptable height to increase grass plants' ability to produce food.
4. Irrigate to match water needs-not by a rigid schedule-to reduce stresses on the grass plants.
5. Fertilize adequately to increase plant health and vigor.
6. Select heat-tolerant bentgrass cultivars.
7. Construct greens with proper techniques and correct any underlying soil problems on existing greens.