Syringing and Hand-Watering Quench Greens' Thirst

Research suggests that the main benefits of syringing and hand-watering may not result from cooling of the turfgrass canopy. Rather, these practices simply give turf a small "drink" when it needs it most.

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To develop a successful cultural program for your turf, you need a basic understanding of the adaptation, characteristics and cultural requirements of turfgrasses and the influence of the environment on their growth and development. The limiting factors in plant growth, in descending order of importance, are light, temperature, moisture and nutrients. All of these factors occur naturally and directly influence your management practices. Thus, you cannot separate your cultural program from the influence of the environment, particularly weather conditions, including:

* Light, which provides the energy to drive photosynthesis.

* Temperature, which determines the rate of growth and metabolism.

* Moisture, which is critical to metabolic processes and heat dissipation.

* Wind, which promotes the transfer of heat and drying conditions.

The Challenge of Irrigation

Turfgrass cultural practices include mowing, fertilizing, irrigating, cultivating (coring, slicing, spiking or vertical mowing), rolling, topdressing and managing pests. While none of these is necessarily more important than any other, one of the most difficult to manage is irrigation.

Turf managers perform irrigation to ensure an adequate supply of moisture for turfgrass growth and to wash fertilizers and pesticides into the soil. In most situations, irrigation is a supplement, not a substitute, for rainfall. Often, however, total annual rainfall is inadequate, and the only way turf can survive is with the water you supply through irrigation. In other regions, adequate rainfall occurs annually to support turf, but its uneven distribution makes irrigation necessary at some times of the year.

What happens to rain or irrigation water in turf? One fate of water is evaporation, the physical change of water from the liquid to the gaseous state. This requires energy. We usually think of the radiant energy from the sun as a cause of evaporation (which it is), but advective and conductive heat transfer also cause evaporation. Transpiration is the loss of water vapor from plants, mostly through the stomata (tiny pores on the leaf surface that plants can open and close). The total amount of water loss-through a combination of water that evaporates from the leaf and soil surfaces, plus the water that plants lose through transpiration-is evapotranspiration, or ET.

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The rate at which turf ET takes place is determined by solar radiation, rooting depth, relative humidity, temperature, wind and soil moisture. Thus, a combination of conditions dealt to you by nature and what you do as a turf manager determines moisture availability and use, and the ability of your turf to thrive or simply survive.

Adequate water is especially critical for plants growing under severe stress conditions. Cool-season grasses during the hot summer months, regardless of location, commonly experience heat stress in combination with moisture stress.

This is especially evident on closely mowed turf areas such as golf course putting greens. Stress on this turf results from a combination of close, frequent mowing; shallow rooting; high ET rates and high air and soil temperatures. Golf course superintendents encounter pressure from golfers to keep greens at extremely low mowing heights, even during periods of summer stress and heavy traffic. This results in a shallow root system that cannot use water found deeper in the soil.

During periods of high ET, internal water stress develops because water loss exceeds water uptake through the root system. Midday wilt, even with sufficient soil moisture, is common on creeping bentgrass and annual bluegrass putting greens, especially on those maintained at extremely low heights. Wilt and even desiccation can occur within a matter of hours on close-cut creeping bentgrass because its limited root system largely is confined to the upper part of the soil profile where high temperatures disrupt normal root function.

Supplemental Irrigation Practices

Creeping bentgrass and annual-bluegrass greens often need supplemental irrigation to survive periods of summer stress. Syringing is the practice of applying small amounts of water, usually 0.10 inch or less, to correct plant-water deficits, reduce plant-tissue temperatures and wash the leaves. Syringing applies water to the canopy, but is not intended to restore soil moisture, as is a typical irrigation. Typically, superintendents syringe in the early morning to remove dew or at midday to moderate temperatures.

It's difficult to objectively evaluate the effectiveness of syringing because research on syringing is limited. Work in the 1970s at Michigan State University found that an application of 0.25 inch of water to 'Toronto' creeping bentgrass reduced canopy temperatures 1.8 to 3.6 degrees F for 2 hours. A Cornell University researcher found that applying 0.12 inch of water to 'Astoria' creeping bentgrass between 11:30 a.m. and 3:00 p.m. resulted in a canopy-temperature reduction of 7.2 degrees F immediately after spraying. However, the cooling effect fell off to only 2.5 degrees F within 10 minutes, and the bentgrass reached pre-syringing canopy temperatures just 15 to 30 minutes after syringing. Researchers at North Carolina State University in the 1980s found that in the absence of wilt symptoms, canopy temperatures of well-watered creeping bentgrass were no different 1 hour after syringing, regardless of the volume of water they applied (0 to 0.21 inch) or timing (12:00, 1:00, 2:00, 3:00 or 4:00 p.m.). These research studies focused on canopy-temperature reduction, and the data do not suggest any long-term benefit of canopy-temperature moderation from syringing.

Hand-Watering

One supplementary-irrigation practice-hand-watering-is not actually new but one that we now better understand. The difference between syringing and hand-watering is the volume of water you apply: hand-watering supplies considerably more water. As golf-course superintendents became more skillful at growing creeping bentgrass under hot and sometimes extremely humid conditions, they became aware that the small volumes of water applied through syringing did not meet the plants' needs. Thus, hand-watering has become more prevalent. Ask anyone who has worked on a golf course, especially from the upper Transition Zone southward, if one of the most important (and least favorite) summer activities is not hand-watering "hotspots" on bentgrass putting greens.

Several years ago, new research methodology made pos-

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sible a study performed at North Carolina State University to better understand the mechanisms by which syringing and hand-watering benefit turf. This problem was the focus of graduate studies for Benny Bennett, Jr. Bennett's main study goal was to determine how syringing and hand-watering treatments affected leaf water potential (a measure of plant-water status-the lower the potential, the greater water stress the plant is under), canopy and soil temperatures and turf quality. Bennett applied supplemental irrigation to a 'Penncross' creeping-bentgrass green growing on a USGA-specification root zone at a syringing rate (0.05 inch) or a hand-watering rate (0.20 inch) at 1:00 p.m. on days when canopy temperatures exceeded 35 degrees C. He measured leaf water potential, canopy temperature and soil temperature before irrigating and at 30, 60 and 120 minutes after the application.

* **Leaf-water potential.** Leaf water potential significantly increased in syringed plots but could not be sustained. A significant decrease in leaf water potential was noted at 60 minutes after syringing. In contrast, leaf water potential of hand-watered plots initially responded similar to syringed plots at 30 minutes after watering, but these increased levels were maintained for much longer (up to 120 minutes after watering). This probably was due to the uptake of water by shallow roots.

* **Canopy temperature.** Bennett observed immediate reductions in canopy temperature after both syringing and hand-watering (reductions ranged from 3.6 to 9.0F at 5 minutes after application . However, 30 minutes after application, canopy temperatures were back to control levels and remained there for the rest of the measurement period. It is unlikely that the differences in canopy temperature that occurred in this study could substantially contribute to creeping-bentgrass survival.

These results suggest that extended cooling of the canopy is not the primary means by which syringing and hand-watering improve turf performance. Rather, supplemental irrigation treatments apparently improve the water status of creeping bentgrass, as evidenced by higher leaf water potentials.

Turf quality in both syringed and hand-watered plots was significantly and visibly better than that of the control plots, which exhibited areas of desiccation and suffered from overall thinning. No increase in disease incidence occurred due to increased moisture in the hand-watered or syringed plots, and syringing and hand-watering treatments did not influence soil temperature in this study. These results validate supplemental irrigation, especially hand-watering, as a means of improving the quality and performance of creeping-bentgrass turf.

Influence of Research on Practice

Compared to full-coverage syringing, hand watering offers more efficient use of water for relieving initial symptoms of drought stress. By using quick couplers with hose-and-nozzle attachments to treat only the areas that have visual indications of heat and moisture stress, you avoid disrupting play and conserve water. Areas such as slopes, ridges or portions of the green that suffer from localized dry spot may need syringing or hand-watering, while the remainder of the green has sufficient moisture.

Continued research should address differing application rates, cultivars and root-zone mixes, as well as root-zone sub-surface air movement and other factors. Our research-based recommendations are improving, but to continue to improve cultural programs and refine Best Management Practices, researchers must continually explore new ideas and reassess standard practices.

(Editor's Note: Dr. Charles H. Peacock is professor of turfgrass science at North Carolina State University (Raleigh, N.C.).