Syringing Can Dramatically Affect Canopy Temperature

By Karl Danneberger and David Gardner

Maintaining creeping bentgrass and/or annual bluegrass putting greens during the summer months is a challenge that faces many superintendents. High summertime temperatures, both air and soil, contribute to the decline of highly maintained putting greens. The decline in turf quality is directly related to morphological changes including reduction in shoot growth, root growth, stand density and leaf size caused by temperatures above the optimum for growth.

Although directly changing the ambient temperature is improbable, modifying the internal plant temperature through management practices is possible. One of those practices, syringing, is often used in an effort to lower turf canopy temperatures. To understand when and where syringing works, a brief overview of factors involved in plant temperature is needed.

Canopy temperature

The turfgrass plant/leaf temperature is governed by three major components — net radiation, convection/conduction and transpiration. Net radiation is the radiation that is absorbed directly from the sun or from long wavelengths reflected by plants or objects in close proximity (heat wavelengths), minus what the plant transmits or reflects.

Radiant energy from the sun can increase the temperature of the plant 13 degrees F to 17 degrees F beyond the ambient temperature. For example, under sunny skies and adequate soil moisture, we have measured creeping bentgrass canopy temperatures of 105 degrees F when the ambient temperature was 88 degrees F. As a general rule, canopy or leaf temperatures are 15 degrees F warmer than the ambient temperature on sunny, still days where soil moisture levels are adequate. Canopy temperatures on cloudy days, however, are closer to the observed ambient temperature.

Dissipation of heat from net radiation is accomplished through conduction/convection and transpiration. Conduction occurs when the air molecules closest to the leaf blade are heated, thus transferring some of the heat away from the leaf blade. Convection occurs when the warmer air near the leaf blade rises, being replaced by colder air. Of these two processes, convection plays the major role in heat dissipation.

Transpiration is basically the transfer of heat from the plant to the atmosphere through evaporation. Evaporation is the process where water is converted from a liquid to a gas and subsequently the conversion of sensible heat to latent heat. Sensible heat is defined as the heat energy stored in a substance (in this case water) as a result of an increase in its temperature. Latent heat is defined as the heat that flows from a material without change to temperature. In this case, the water would go from a liquid to a vapor.

The conversion of water from a liquid to a gas requires 570 calories per gram of water. Thus the removal of this heat energy through evaporation is how the plant cools itself.

Stomates (small openings in the plant where the water vapor escapes) play an important role in the ability of plants to transpire. The water vapor that surrounds the leaf blade is termed the boundary layer. The thickness of the boundary layer is dependent on the transpiration rate, relative humidity and wind velocity. The thicker the boundary layer is, the greater the resistance to transpiration (and thus cooling) is.

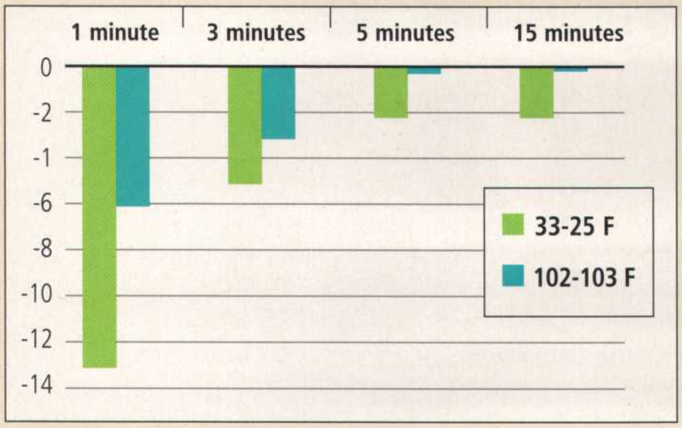
The boundary layer is thicker if the relative humidity is high and little wind is present. Conversely, if relative humidity is low and wind is present, the boundary layer is thinner.

Air movement cannot be overemphasized in its role as a cooling mechanism for turfgrass plants. In our studies, we have observed that a slight breeze (less than or equal to 5 mph) can result in a 7 degree F to 10 degree F drop in the canopy temperature. From a practical standpoint on sunny calm days, the use of a fan around greens with restricted air movement during the afternoon can help alleviate heat buildup.

Continued on page 64

FIGURE 1

The effects of syringing water temperature on the *canopy* temperature of creeping bentgrass turf mowed at fairway heights.



▲ **Figure 1.** The y-axis is the difference between the syringed canopy temperature and the nonsyringed canopy temperature. In this case, 0 would represent no difference in temperature between the syringed and nonsyringed. The more negative the number the greater the temperature depression caused by syringing.

Continued from page 63

Syringing: Mechanism to cool the plant?

Syringing is the light application of water to the turf to prevent wilt and reduce the canopy temperature. There is no exact amount of water applied during syringing that defines this practice.

In several published studies, the amount of water used for syringing varies from .06 to .25 inches per application as a definition of a syringe treatment. The effect of syringing on canopy temperature is variable depending on the environmental conditions present. In situations where wilt is occurring, syringing effects are dramatic. Where localized dry spot areas were syringed, the canopy temperatures were lowered 25 degrees F for more than an hour. In the same study, syringing areas showing visible wilting reduced canopy temperatures 10 degrees F to 15 degrees F. The application of a light amount of water to a moisture-stressed turf is effective in alleviating the stress.

In situations where wilt is not present, the effects of syringing appear to be minor. A Michigan study reported canopy temperature depression of 2 degrees F to 3.5 degrees F for two hours on a creeping bentgrass turf. In North Carolina, syringing did not significantly reduce the canopy temperature on non-wilting creeping bentgrass maintained at putting green heights. The author questioned the use of syringing under adequate soil moisture.

However, in a study conducted in Alabama, syringing was found to reduce soil temperatures when air temperatures were above 90 degrees F.

Our studies this past year confirmed several of the conclusions reported in prior studies. On a creeping bentgrass turf maintained at fairway height under wilt-free conditions, we found syringing had little effect on reducing canopy temperatures beyond 10 minutes. We did, however, find that what canopy cooling effect we did observe was greatest when ambient air temperature was high (more than 88 degrees F).

Additionally, we looked at what effect the water temperature would have on cooling. Comparing a cold water (meaning a water temperature between 33 degrees F and 35 degrees F) and a warm water (meaning a water temperature between102 degrees F to 103 degrees F), syringe, no difference in canopy temperature was detected beyond the first minute (Figure 1). This would be expected, given the nature of latent heat transfer mentioned previously in water evaporation.

Summary

Syringing applied under wilting conditions has a dramatic effect on canopy temperature. Under nonlimiting soil moisture conditions, syringing has little to minor impact on lowering canopy temperature. However, as ambient temperatures increase, the effects of syringing increase.

Danneberger and Gardner are members of the Department of Horticulture and Crop Science at The Ohio State University.

REFERENCES

Danneberger, T.K. and S. White. 1988. "Treating Localized Dry Spots." *Golf Course Management* 56(2):6-10.

Danneberger, T.K. and Yan, J. 2003. "Does the temperature of the water affect syringing?" *Superintendents' Korner.* Aug. 8, 2003. *http://hcs.osu.edu/sk*

DiPaola, J.M. "Syringing effects on the canopy temperatures of bentgrass greens." *Agronomy Journal* 76:951-953.

Duff, D.T. and J.B. Beard. 1966. "Effects of air movements and syringing on the microclimate of bentgrass turf." *Agronomy Journal* 58:495-497.

Guertal, E. and D. Han. 2002. "Fans and syringing for cooling creeping bentgrass putting greens." *Golf Course Management* 70(7):57-60.