Be afraid of the dark

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The summer of 2012 was historically unpleasant for turfgrass managers, harkening comparisons to the infamously brutal summers of 1995 and 1988. Much of the region was mired in a severe drought, and record high temperatures ruined many July 4th festivities (and emptied tee sheets). While the record high temperatures certainly got the attention of the public at large, as turfgrass managers, what should have concerned us most were the nighttime temperatures.

There are a couple reasons for the importance of nighttime temperatures to turfgrass health. As any Turfgrass Diagnostic Lab contract member would know, I always harp on the forecasted nighttime lows when discussing potential diseases to watch out for. The primary reason is that higher nighttime temperatures nearly always equal higher humidity, due to the fact that moisture can hold heat better than air can. As we're well aware, higher humidity usually equals more disease. Sustained nighttime lows above 65°F often signal that dollar spot will become more active, and lows above 70°F for more than three days often signal that it's time to start worrying about Pythium blight and brown patch.

Warm nighttime temperatures go beyond just disease activity, though. As we all know, plants are unique in that they produce their own food. They accomplish this by using the sun's energy to power the conversion of carbon dioxide and water to sugars the plants can use, a process known as photosynthesis. Because the sun powers the photosynthetic production of food, photosynthesis only occurs during the daytime hours. As important as photosynthesis is, though, it only produces the food. To convert that food into energy, a second process called respiration occurs. Respiration is highly conserved amongst life on earth, and occurs in nearly the exact same manner in plants, animals, and other organisms. Respiration occurs 24 hours a day and breaks down the food produced through photosynthesis to energy the plants can use to survive. Since photosynthesis occurs only during the day, and respiration is occurring at all times, there is a period during the night where food is only being consumed and not produced.

What this means is that the plant needs to produce enough food during the daytime hours to sustain itself throughout the night as well. During sunny conditions with temperatures between 65-75°F, the plant produces enough food to sustain the plant through the night and also has extra left over to support plant growth (Figure 1). Different conditions can lower the amount of food available, either through reducing the amount of food produced or by using it up faster. Reduced sunlight due to shade or low mowing heights will lower photosynthetic production, resulting in a lack of food. Temperatures above 85°F begin to decrease the efficiency of photosynthesis through a process called photorespiration, a process that also decreases the amount of food produced. In addition, higher temperatures increase the rate of respiration in the plant cell, which can lead to faster utilization of resources.

This becomes especially problematic during periods with high

nighttime temperatures. Warm nighttime temperatures increase the rate of respiration, and there is no photosynthesis occurring to compensate with more food. This can lead to energy deficits, which if prolonged, can lead to poor rooting and eventually turfgrass death (Figure 2). This condition, when coupled with a multitude of other stressful summer conditions, has been referred to as summer stress syndrome.

Can anything be done to prevent summer stress syndrome? Well obviously you can't affect the nightly low temperatures, but there are a few things you can do to lessen the impact of a stressful summer similar to 2012. First, raise cutting heights to the absolute highest you can afford to. Even minor increases can help increase rates of photosynthesis, and research from Michigan State has shown that rolling can help maintain putting green speed. Second, syringing the turf in the late morning will cool the turf plants shortly before entering the warmest portion of the day. This can help to lower the canopy temperature, decreasing the rate of respiration. Third, ensure proper drainage by keeping the organic matter in the putting green rootzone below 4%. Excess water in the rootzone can prevent oxygen flow and hold more heat in the soil, which can increase respiration during the night.

Many superintendents have followed these recommendations and have still struggled to keep turfgrass alive in 2012. To be fair, little can be done when conditions are as extreme as they were last summer. This is especially true for facilities that can't dispatch small armies to hand water struggling areas throughout the day. But with every hot day that passes this summer, it's comforting to know we're one day closer to fall.

Figure 1. Hypothetical graph showing energy produced from photosynthesis and energy used from respiration at a daytime high of 75°F and a nighttime low of 55°F.

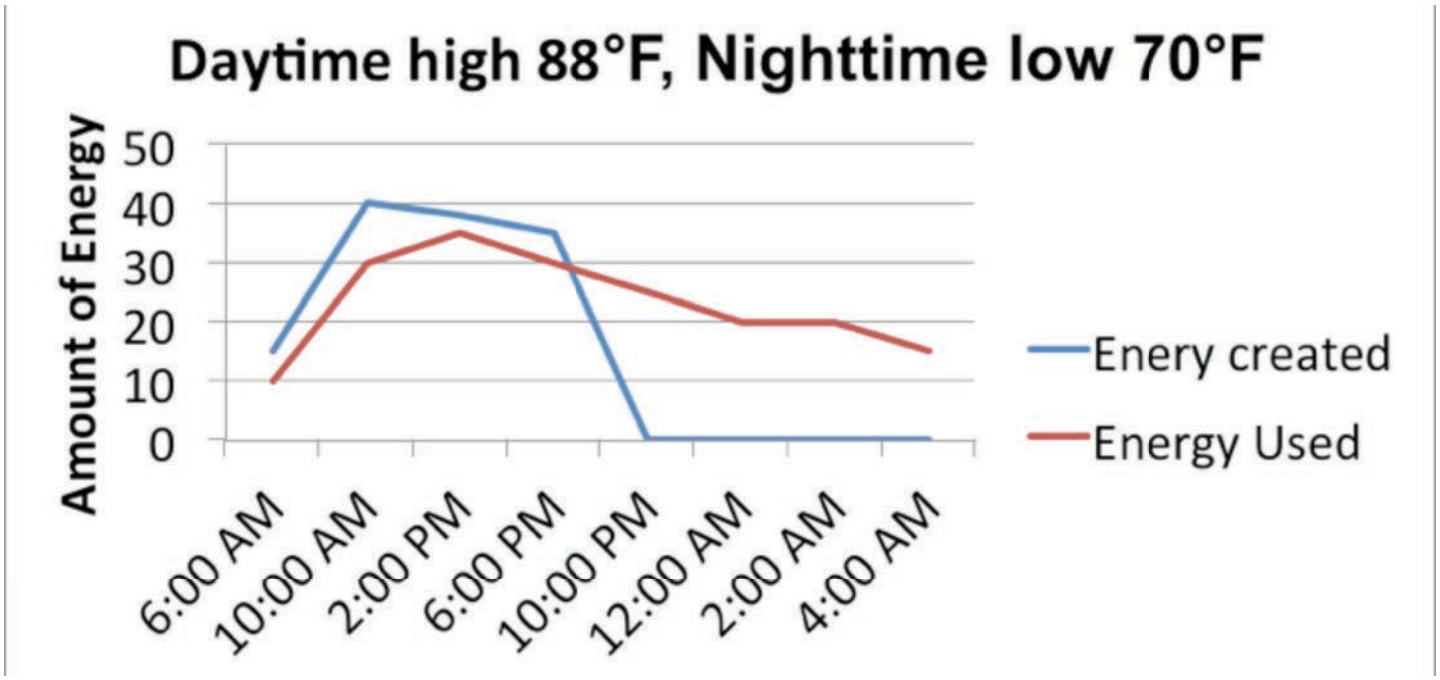

Figure 2. Hypothetical graph showing energy produced from photosynthesis and energy used from respiration at a daytime high of 85°F and a nighttime low of 70°F.