

# Understanding Wet Wilt

Shedding some light on an unfamiliar subject.

BY PETER H. DERNOEDEN

The purpose of this article is to discuss wet wilt, a problem in turfgrasses that is not well understood or studied. Indeed, there are only a few, vague references to wet wilt in turfgrass textbooks, including Dr. James B. Beard's *Turf Management for Golf Courses*. The summer of 2005 was not the hottest or wettest in the last 25 years in the Mid-Atlantic Region, but it was among the most stressful, with significant losses of turfgrass on greens. During July and August in the Baltimore-Washington, D.C., corridor, there were more than 22 days when the daytime temperature exceeded 90°F.

Average nighttime temperatures were in the low to mid-70s, daily humidity averaged over 78%, and there were numerous thunderstorms. Trouble on many golf courses in the region began following an especially severe tropical storm on July 16. There was, however, heavy thunderstorm activity before and after July 16, 2005. Too much water generally is more destructive than drought to most golf course turfs in summer. Water on the surface or in thatch absorbs heat from the sun. The heat is transferred into the rootzone by soil water and stored. This is why soil temperatures in wet putting greens on hot and sunny days often are several degrees warmer than the air temperature. In the weeks that followed, nearly every golf course in the region experienced some amount of turf loss. Turf losses on greens, tees, fairways, and roughs were especially acute in water drainage patterns or wherever water puddled or slowly drained. Rapid losses of turf were especially severe where aggressive mowing and grooming prac-



Scald on a bentgrass tee is evident due to water perching between a shallow sand rootzone mix and the native soil.

tices (for green speed) were maintained. Basically, turf was damaged or killed by a combination of excessively wet soils and high day and nighttime temperatures. Mechanical injury from mowers (particularly those equipped with grooved rollers) and fertilizer and chemical burns were common contributing factors to turf loss. Strangely, at least in the Baltimore-Washington, D.C., corridor, only Pythium blight and brown patch were chronic disease problems. Bacterial wilt, take-all patch, and fairy ring on greens and dollar spot in roughs were troublesome for some golf courses; however, anthracnose and Pythium-incited root diseases were uncommon.

## HEAT STRESS

Heat stress is a common summertime problem in many regions of the U.S.

For cool-season grasses, heat stress begins when air and soil temperatures exceed 86°F. Root stress in creeping bentgrass, however, can begin at soil temperatures as low as 73°F. There are two basic types of heat stress: direct and indirect.

In general, indirect heat stress can be expected to occur when air and soil temperatures exceed 86°F for prolonged periods. When cool-season grasses are subjected to indirect heat stress, root and shoot growth decreases. Reduced growth is followed by root dieback, loss of turf vigor, density and green color, and possibly death of plants. High-temperature stress also results in an increase in respiration and a decrease in carbohydrate production (i.e., photosynthesis). Carbohydrates are an important source of energy for sustaining



shoot and root growth. The imbalance between respiration (use of carbohydrates) and photosynthesis (production of carbohydrates) during periods of heat stress results in a weakened ability of plants to repair themselves, particularly on putting greens. Symptoms of indirect heat stress often appear as a general yellowing or chlorosis, which oftentimes is confused as a disease or nutritional problem.

Direct heat stress occurs in response to a rapid increase in temperatures exceeding 104°F for a relatively short period of time. The most common type of direct heat stress is scald, which occurs when plants are inundated by water. Wet wilt is a stress phenomenon that occurs under several very specific environmental conditions and bridges the definitions of indirect and direct heat stress. While scald was commonplace on tees, fairways, and roughs, it was wet wilt that was a major killer of putting green turf in the Mid-Atlantic Region in July and August of 2005.

The optimum temperature for root growth of cool-season grasses ranges from 50°F to 65°F. New root initiation ceases at a soil temperature of 80°F. Soil temperatures above 86°F will cause root growth to stop and roots to begin to lose their ability to function, and the natural aging process of the existing root system begins. Plants that lose a major portion of their root system in summer, however, sometimes begin to generate new roots, despite high soil temperatures. Roots that do regenerate in the summer are most often found growing in aeration holes. Research is underway at the University of Maryland to study and better understand this phenomenon.

## SOIL TEMPERATURES AND SCALD

Soil temperatures have a huge effect on the root systems of grasses. Bentgrass plants on greens normally have pearly white roots that extend 4 to 6 inches or deeper in soil in spring. Often, however,

they turn brown and are primarily restricted to the upper 0.5 to 2.0 inches (1 to 5 cm) of soil by late July, when soil temperatures routinely exceed 86°F. Heat stress injury in the rootzone accelerates in wet soils during the summer. On sunny days when air temperatures exceed 90°F, the temperature in the upper 2.0 inches of wet soil can range from 95°F to 100°F. These conditions led to root dysfunction and/or a rapid loss of roots in putting green turf in 2005. Wet soils accumulate heat slowly, but they retain more heat for longer periods, particularly on putting greens where canopy height is normally ≤0.135 inch. Heat retention, however, is more pronounced in native soil versus sand. Plants can condition themselves to tolerate high temperatures, but in most cases large portions of root systems die in response to soil heating, low soil oxygen levels, and/or elevated CO<sub>2</sub> levels as a result of too much water. If water puddles due to heavy rain, over-irrigation or poor surface drainage and inundates plants during sunny and hot weather, turf can be killed or severely damaged in just a few hours. This phenomenon is called scald, and it occurs in response to a rapid heat buildup (>104°F) in standing water in a few hours, which causes proteins to denature followed by plant death. Oxygen depletion (anaerobiosis) also plays a key role in plant death during a scald event. The injury pattern may be random, but scald damage is most severe in low areas where water puddles. A scald-like condition also can occur where there is a significant thatch and/or mat layer (i.e., >0.5 inch). Sunny, hot days that immediately follow a heavy rain can cause excessive heating in a water-saturated thatch and mat layer, which may result in either indirect or direct heat stress.

## WET WILT

Wet wilt occurs when there is adequate soil moisture, yet roots cannot absorb water fast enough to meet the transpirational (i.e., a natural cooling process

in which water moves from the roots to the shoots and evaporates through openings on leaves called stomates) needs of a plant. This can occur in plants with a limited root system on sunny, warm-to-hot days when there is low humidity and windy conditions. The aforementioned conditions cause stomates to close, and this results in an internal water deficit, which is lethal to plants. Wet wilt also can occur during hot and humid periods when soils are waterlogged. It was this type of wet wilt that was a major factor in turf loss on greens in July and early August 2005. Night temperatures and humidity were very high and turf on greens had little or no relief from high daytime temperature stress. Hence, turf on greens had no ability to recover during this period unless the greens had the benefit of good air circulation and internal soil water drainage. Due to a combination of high soil moisture, low soil oxygen levels, heat stress and stomatal closure, roots were unable to absorb water. Indeed, turf almost literally “cooks” in hot and wet soils. Affected greens initially appeared brownish and water-soaked. Turf soon thinned out in irregular shapes, but damage often followed the natural drainage pattern of the green. It also was common to see damage on the front of sloped greens, where surface water exits and golfers enter the green. Eventually, leaves and sheaths collapsed, turned white, and matted. A week or two later, dead areas developed a blackish appearance. Generally, it was the combination of heat stress, hot waterlogged soils, and mechanical injury from mowing that caused leaves to collapse. It is very difficult to separate damage occurring due to wet wilt versus indirect or direct heat kill (i.e., scald), as these conditions can be inter-related. Oftentimes, any number of turfgrass diseases are blamed or confused as a cause of this type of turf loss. Even when pathogens are present, disease may not be the main cause of the problem.





This mostly annual bluegrass putting green was severely damaged by spiking in the heat of the day during a wet wilt event.

## MANAGEMENT OPTIONS

Whenever greens are showing signs of injury from wet wilt or other summer stresses, the height of cut should be increased and mowing frequency decreased. On weak and thinning greens, mowing should be reduced to no more than four or five times per week, and mowing height should be increased to at least 0.150 inch. Increasing mowing height increases leaf area, which improves the ability of plants to produce carbohydrates and to naturally cool via transpiration. An increase in canopy height may help to slightly moderate soil temperature and alleviate stress in the rootzone. It is very important to replace grooved rollers with solid rollers and disengage or remove grooming devices (i.e., brushes and verticutters) once summer stress conditions begin to slow turf growth and recuperative potential. During especially hot and humid periods it is prudent to use lightweight, walk-behind greensmowers equipped with non-abrasive, solid rollers. Although using walk-behind mowers may be impractical for all greens, it certainly would be beneficial to greens that are obviously weakened and showing a loss of turf. Avoid mowing greens in the morning following a major rain event during periods of heat

stress. It is when mowers “push water” (i.e., when casual water exists on a green) that loss of turf can be especially severe. Some turf managers substitute rolling for mowing when conditions permit. Greens suffering from heat stress, wet wilt or anaerobic conditions must be carefully managed, and reducing mower stress is essential to turf survival.

Greens suffering from wet wilt stress should not be brushed, vertical cut, top-dressed, or otherwise abused mechanically. When soils are excessively wet during summer, irrigation should be avoided until soils become dry enough to require overhead irrigation. During conditions of dry-wilt stress, syringing is recommended to cool the canopy. Syringing can be very helpful during periods of wet wilt, but if water does not evaporate between syringes, the canopy is not cooled. Syringing during wet wilt only can be effectively achieved when an extremely light film of water is delivered to the canopy several times a day. This is best performed by an individual using a hose and nozzle that delivers a mist, rather than using the overhead irrigation system, which can apply too much water to the stressed grass. Fans can be highly effective in cooling the canopy. The moving air

provided by fans helps to remove moisture from the canopy, which enables stomates to open. Once stomates open, water can move along a gradient from soil to roots to shoots and out stomatal openings on leaves, which cools the plant. Hence, during conditions of wet wilt, only fans and very light syringes are likely to provide for sufficient cooling of severely heat-stressed turf.

It is very important to promote soil aeration. Roots need soil oxygen to survive. Greens affected by wet wilt should be solid-tine aerated or spiked, but only when it is possible to safely use this equipment on putting surfaces. During periods of wet wilt, it is best to aerate and/or spike in the evening as temperatures are falling. Early morning is the next best time, but all aeration operations should be completed by 8 a.m. on days when air temperatures above 86°F are expected. Aerating and/or spiking in the heat of the day during a wet-wilt event will likely result in extreme damage to putting greens. Once heat stress abates, foliar applications of nitrogen (0.1 to 0.125 lb. N per 1,000 sq. ft.) applied weekly will help turf to recover. Plant protection chemicals should be applied to control any turf disease that may be active. Suspension of plant growth regulator use until putting surfaces have fully recovered would be prudent.

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