Heat-Stress Physiology and Management

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High temperature is an important environmental factor limiting the growth and persistence of turfgrass species in areas where temperatures exceed the maximum for optimal growth. Although heat stress is often associated with injury to cool-season grasses during the summer months, injury to warm-season grasses can also occur. The problems of high-temperature stress are expected to become more significant in the future due to predictions that a rise of 1 to 4.5°C in the mean global temperature may take place in the next 50 yr (Hansen et al., 2006). The future trend of elevated temperatures indicates that there will be extended periods of high temperatures coupled with greater temperature extremes throughout most of the temperate zone, a situation that could intensify heat injury to plants, particularly cool-season turfgrasses. An increase in the internal temperature of plants to above-optimal levels, even transiently, has a significant impact on the physiological and biochemical processes of the plants and inhibits their growth (Singla et al., 1997). Unlike homoeothermic animals, plants have a limited capacity to maintain optimal internal temperatures in hot environments and must rely primarily on transpirational cooling and morphological and anatomical modifications to avoid heat damage.

Plant responses to heat stress begin at the cellular level with changes in membrane fluidity and protein function and are followed by disruptions in carbon metabolism and protein and hormone synthesis. Heat-induced disturbances in plant metabolism are then manifested at the whole-plant level as reductions in shoot and root biomass and as increased leaf senescence. Therefore, understanding the mechanisms of heat tolerance and using management practices that can effectively prevent, alleviate, or improve heat tolerance of turfgrasses are critical for producing and maintaining high-quality turf in warm climates. This chapter will review changes in major physiological processes and resistance mechanisms.