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Heat Stress Causes and Prevention

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There is a lack of understanding concerning plant stress resulting from super-optimal temperatures. Thus, the thrust of this article is to provide an understanding of the heat stress kill mechanism and heat stress resistance, plus the cultural approaches for minimizing heat stress.

HEAT STRESS CAUSES

Heat stress is most commonly a problem with C_3, cool-season turfgrasses, especially when attempts are made to extend their use into the warm climatic regions. **Heat stress typically is most severe on turfgrasses under conditions characterized by extraordinarily high temperatures and high humidities that are sustained for several months.** Periods with an absence of wind movement further accentuate the stratification of high temperature and humidity levels near the surface of the turfgrass. Early summer high air temperatures with cool soil temperatures are not nearly as stressful as late summer periods when both the air and soil temperatures are at heat stress levels. This is because **a high soil temperature is the most critical heat pool affecting the turfgrass plant.** Also, regions with hot days and cool nights sustain cooler soil temperatures and less potential for heat stress.

Lethal heat stress results from the coagulation/destruction of the critical protoplasmic proteins in living cells. **Plant death of cool-season turfgrasses occurs at tissue temperatures of 104°F (40°C) and higher, depending on the particular species and cultivar.** The heat stress injury may be direct and acute, or indirect and more chronic in nature. Visual signs of injury from acute heat stress are first observed via cross sections of grass shoots as a darkened area at the junction of the leaf blade and leaf sheath of the second and third youngest leaves. A progression of plant stresses occur during chronic heat stress as follows:

Chronology of Progressive Chronic Heat Stress on Turfgrasses

- Increased rate of root maturation.
- Death of the roots.
- Decline in shoot growth.
- Cessation of new root growth.
- Reduced leaf length and width.
- Decreased rate of new leaf appearance.
- Leaves turn dark-green to blue-green.
- Death of leaves and shoots.
- Death of nodes on crowns/lateral stems.

HEAT STRESS RESISTANCE

Heat resistance is the ability to survive an externally imposed high temperature stress. When assessing research reports of heat stress resistance of turfgrass cultivars, it is important to understand that there are two types of heat resistance: (a) heat avoidance and (b) heat tolerance. **Heat avoidance** is the ability to sustain internal tissue temperatures below lethal heat stress levels via transpirational cooling. The higher the evapotranspiration rate of a cultivar, the greater the heat avoidance, assuming adequate rooting can be sustained for water uptake. In contrast, **heat toler-**

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