A PRACTICAL RESEARCH DIGEST FOR TURF MANAGERS

TURFGRASS TRENDS

Volume 8, Issue 8 • August 2000

AGRONOMY

Freeze-Stress Resistance

How freeze-stress resistance in perennial ryegrass relates to turfgrass performance

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Each winter in New England and the northern United States, substantial turf losses occur due to injury from freezing temperatures. Turf injury and losses that result from freezing temperatures can have an economic and environmental impact on the functional quality and aesthetic value of turf areas. Turf loss results in increased weed pressure and herbicide cost, increased soil erosion, decreased use and, in the end, the need for costly and extensive re-establishment (Dipaola and Beard, 1992).

Turfgrass species and varieties vary considerably in their tolerance to freezing stress (Gusta et al., 1980). Perennial ryegrass (Lolium perenne L.) has been reported to have the poorest low temperature tolerance among cool-season turfgrass species (Beard, 1973). However, cultivars of perennial ryegrass can vary widely in their lethal killing temperatures (LT_{50}), ranging from -5 to -15 °C (Gusta et al., 1980).

Despite having poor low temperature tolerance, perennial ryegrass is still one of the most important and widely used species in the northern United States (Meyer and Funk, 1989; Watson et al., 1992). Its ability to establish quickly makes it a popular choice of turf managers for overseeding fairways, institutional grounds, parks, home lawns and in lawn care operations. It is expected that the popularity of perennial ryegrass will continue to increase in the northeast and elsewhere with the release of new and improved cultivars.

Turfgrass freezing stress

Turfgrass freezing stress occurs at 0 °C (32 °F) and colder temperatures. Injury to turfgrass due to freezing temperatures involves the formation of ice crystals in and around the cells of the regenerative region of the plant (Beard, 1973; Rossi, 1997). The regenerative region of a turfgrass plant, also known as the crown, is the region that includes the stem apex, the unelongated internodes and the lower nodes from which the adventitious roots are initiated (Hull, 2000). Since adventitious roots, lateral shoots (tillers, rhizomes, and stolons) and leaves all initiate from this region, the crown tissue is considered the most vital portion of a turfgrass plant (Beard, 1973; Hull, 2000).

If temperatures drop quickly, intracellular freezing will occur in tissues, especially those having high tissue hydration levels. The ice crystals cause a mechanical disruption to the cell membranes that result in death of the tissue. The lysis of cells with the release of cell contents from this type of injury can be measured in the laboratory using electrolyte leakage methods. This approach is effective in identifying injury at the cellular level.

AN ADVANSTAR ★ PUBLICATION

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