Compilation of Summaries of Short Winter Articles

Submitted by CHRIS HOFF
Precision Turf & Chemical, Inc.

Physiology, Plant Stress, Winter Injury: Summaries

Survivability of Anoxia Under Ice and Impermeable Covers (2008)

By Darryl Asher, Todd Paquette and Jim Ross

Previous research conducted at the Prairie Turfgrass Research Centre (Olds, Alberta, Canada) showed that there was a rapid loss of relative hardiness of annual bluegrass plants between 45 and 60 days under continual ice cover (Tompkins, Ross and Moroz, 2004), while plants in non-iced conditions lost hardiness very slowly. The fact that air cannot be replenished under ice cover, or an impermeable covering of any sort, was thought to be a factor contributing to the injury. Research conducted in Quebec found that under an impermeable cover oxygen was depleted and carbon dioxide increased (Rochette et al, 2006). This increase was attributed to use by the plants and to low temperature microbes. When oxygen is completely depleted, the condition is known as anoxia.

In earlier research, Beard (1965) had similar results and found that injury to annual bluegrass occurred 75 days after continual ice cover. However, it seems that creeping bentgrass is affected much less and in our research was still alive after 120 days of continual ice cover. Other researchers found that differential sensitivity to conditions of anoxia was common amongst various plant species (Bertrand et al, 2001).

So what happens to annual bluegrass between 45 and 60 days when air cannot be replenished?

It seems that under conditions of anoxia a rapid depletion of stored foods occurs. We know that these stored foods act as an anti-freeze agent for plants so when they are completely depleted the plants have lost their ability to resist freezing. And, of course, once they freeze irreversible cell damage occurs and plants die.

At this point, we think that when oxygen is fully depleted rapid utilization of food reserves occurs, which in turn causes a rapid loss of hardiness (between 45 and 60 days). Once food reserves are depleted, the plant begins to utilize energy that is provided by a process called glycolysis. However, the energy produced is not sufficient to sustain the plant. This deficit also leads to the induction of fermentation metabolism and to an increase in the production of potentially phytotoxic metabolites such as ethanol, lactic acid and carbon dioxide (Rochette et al, 2009).

So it appears that injury results from either a toxic build-up of these gases or from a complete depletion of food reserves. In the Quebec study, high levels of carbon dioxide did not produce mortality, so that may be an indication that the depletion of food reserves is the reason for the injury.

Mitigation of Anoxia Under Ice and Impermeable Covers on Annual Bluegrass Putting Greens (2008)

By Darrell Tompkins, Philippe Rochette and Jim Ross

Winter damage to annual bluegrass putting greens caused by a lack of oxygen under ice or impermeable winter covers is an important problem in cold climates. The objective of this trial was to evaluate various covering systems that would increase oxygen levels and, in turn, prevent damage associated with anoxia (lack of oxygen). Impermeable winter covers, some with an insulating air layer, were compared against ice cover and snow cover only treatments. Additional treatments to examine air replenishment under the covers were also evaluated.

Oxygen content under the various treatments remained constant for the first 75 days of the trial. However by day 90, there was a significant reduction in oxygen levels for the ice only and the ice, impermeable cover, no air layer treatments. In addition, the ice only treatment was significantly lower than the ice, impermeable cover, no air layer treatment. Air replenishment did not appear to have an impact on oxygen concentration.

Carbon dioxide levels were lowest for the no ice, no cover treatment. On day 90, the highest levels were for the ice, snow cover only and ice, impermeable cover, no air layer treatments. There seemed to be some improvement in carbon dioxide levels with the Enkamat and bubble wrap treatments.

Ice, snow cover only treatments were dead in both years of the study.

As data for turf quality and relative hardiness levels were not yet completed for this trial, it is preliminary in nature.

Strategies for Removing Ice from Annual Bluegrass Golf Greens (2005)

By Darrell Tompkins, Jim Ross and M. A. Anderson

Ice cover on annual bluegrass (Poa annua L.) putting greens often causes damage in the cold climates of North America during long winters. The objective of this study was to evaluate various ice removal strategies for use on annual bluegrass putting greens. In addition, the various products were evaluated for turf injury (damage caused by the product). An initial screening study was conducted in order to choose the best treatments for the field study. Selection of treatments was based on effectiveness and turf injury caused by the products.

Results of the five separate field tests showed that where there was ice removal turf was not improved with the use of covering materials. As far as the individual treatments were concerned, the Landscape and Alaskan ice melters had the greatest effect on reducing ice hardness, increasing ice melt and reducing the ice bond. The methanol was not as effective as either of the granular ice melters in the three tested parameters. The radiant heat producing materials, black sand and Milorganite, appeared to be more effective when light intensities were greater in the late winter study. It also appeared that full sun improved their performance.

This field trial was conducted over a three-year period to attempt to determine turf injury as a result of the various products. Turf injury was measured as percent area damage. There were no differences in turf injury when considering the covering materials. On one occasion Alaskan Ice Melter caused greater injury than any of the other treatments. Landscape Ice Melter also had significantly more injury than the other treatments. Methanol, Milorganite and black sand had injury that was similar to the untreated control.

Relative hardiness levels were measured in year three to determine whether the different ice melting strategies negatively impacted hardiness levels. The early winter test of year three showed that there

(Continued on Page 11)