Surviving An Icy Winter

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Editors Note: Mr. Brad DeBels is a PhD student under Dr. Soldat. His research is based on water conservation and quality for turfgrass. This article is eligible for the Monroe Miller Literary Scholarship awarded to the best student written article each year.

For those of you that had the displeasure of dealing with the icy winter of 2005, you may remember the significant turf loss that ensued that spring. The discussions that arose initiated an article written by Dr. John Stier, now with the University of Tennessee, that discussed types of ice formation and damage. Since that year ice damage has been of minimal concern in the region, until this winter. As this article is being written I look out of the O.J. Noer windows and see acres of ice cover, but yet the extent of the damage will be unknown until spring. With that I think it is relevant to revisit the implications of ice cover on turf and things we may have learned.

Wisconsin Weather…Yikes!

The month of January was mildly rolling along when the Wisconsin weather pattern displayed its true colors. An arctic blast with high temperatures rarely in the double digits starting on the 20th of January, followed by a record high of 54°F with nearly 2 inches of rain on January 29th, trailed by once again freezing temperatures and more than 6 inches of snow. Even with the high temperatures, much of the soil remained frozen other than the top inch or less, leaving us with significant flooding of low lying areas and eventual ice cover and encasement of much of our landscape. So, how much should we worry about spring turf recovery and what affects the potential for regrowth?

Ice Cover

Many of our cool season grasses are relatively invulnerable to ice damage, but not all ice cover poses the same risks. Two major forms of ice damage turf; direct ice cover and ice encasement. Direct ice cover injury results from ice acting as a barrier to gas exchange between the turf tissue and atmosphere. Turf kill will result from oxygen suffocation (anoxia) or accumulation of toxic gases such as carbon dioxide, methane and cyanide between the ice layer and turf. These gases come from oxidation of living tissue, thatch, soil organic matter and/or respiration of low temperature fungi.

Unfortunately there has not been extensive research conducted on ice cover in the last few decades, likely because ice damage is rare in the northern part of the United States, but much of the U.S. doesn't even see snowfall. Annual bluegrass has been observed to survive 60 days, Kentucky bluegrass 75 days, and creeping bentgrass more than 90 days under continual ice cover (Beard, 1964). Luckily here in Wisconsin, if we see ice cover, we rarely see more than two months of consistent ice cover. Because the damage is attributed to gas exchange, it is important to consider the type of ice as well. Clear, dense ice allows for little if any gas diffusion, whereas cloudy, low density ice will allow for more gas diffusion prolonging turf survival.

Ice Encasement

The second type of ice damage is caused by ice encasement. Ice encasement is most easily defined as a situation in which the soil becomes frozen when saturated, either after a rainfall or freeze/thaw cycles, with a significant surface ice layer. This removes oxygen from the soil which is needed for plant growth, even in winter, and may also cause unneeded crown hydration. The elevated crown hydration level increases the freezing and killing temperature of the plant promoting the formation of intra- or intercellular ice crystals.

Ice damage, spring 2004. Photo courtesy of Dr. Paul Koch.

Intracellular ice crystal formation (ice flashing) is rare, but occurs when temperatures fall rapidly and ice crystals form in cells and destroy plant membranes causing rapid death. Intercellular ice crystal formation is when ice forms between the cells and draws water out of cell, due to the lower vapor pressure of ice, and the cell desiccates.

In a field study, Kentucky bluegrass was completely dead with no spring regrowth after 6 days of being frozen under a compacted slush layer and creeping bentgrass had 20% crown death (Beard, 1965). In a laboratory study, Tompkins et al. (2004) found living tissue to remain after 75 days of ice encasement of annual bluegrass and after 150 days for creeping bentgrass at 25 ºF. The Tomkins et al. study shows a much longer survival period of turfgrass under ice encasement conditions, but laboratory studies often have difficulty simulating the fluctuating air temperatures of winter which may reduce cold hardiness. It is also notable that the lab study occurred at 25ºF, a relatively high temperature when considering cellular ice crystal formation during Wisconsin winters. Either way, this demonstrates the variability of cell death due to ice formation and cover.

Ice Prevention and Removal

While we can examine data and select more cold tolerant species, there is often little we can do to prevent ice damage aside from constructing surfaces with optimal surface drainage to allow for rapid removal of winter rainfall and snow melt. The actual removal of ice after formation is much more problematic. I have seen sand or fertilizer being applied to speed ice melt, where the low albedo material absorbs thermal energy. Removal via aerator and shovels and the plowing of greens in late winter to expose ice to sunlight may also work. Possibly the best advancement in recent years have been related to putting green covers that are impermeable and/or have a thin insulated layer which allows for gas exchange.

With any tactic, we must consider the effects of our remedy on exceedingly early spring green up and possible damage during ice removal. Preparing our turf for winter by proper mowing, fertilization, drainage, shade management, topdressing and aeration practices can all promote cold hardiness of turf, but occasionally Mother Nature will prove that much of this management is futile. We must realize many of our turfgrass plants are extremely hardy and rarely do we see conditions that require extraordinary means to remove ice. Understanding the type of ice damage possible and resiliency of your turf is important, but a few prayers for warm weather may also go a long way.

References

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