Winter Kill! What Are You Going To Do About It?

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(Will you prepare your grasses for winter? When the stress of the season is past, let me remind you of what may come — winter injury.)

There are several forms of winter injury that can occur to cool-season turgrasses and these included ice encasement, traffic damage, low temperature diseases and freezing injury. Is there anything you can do to prevent or at least lessen the severity of winter injury?

Many of you have heard the term "crown hydration", which is associated with the idea that grass plants hydrate in response to warm temperatures in the spring and then are irreversibly injured by low temperatures. Unfortunately, this phenomenon has received only limited attention of researchers to pinpoint the mechanisms of dehardening and what conditions are necessary for it to occur. In one study, researchers found it takes only 4 days of 40°F for perennial ryegrass to deharden, indicating how easily this process occurs.

Another theory is "crown dehydration". This involves grass plants losing so much water that they are severely injured and cannot commerce normal metabolic processes in the spring. Scientists have determined that the formation of ice crystals between cells actually draws water out of cells causing dehydration, but how lethal such processes are to turfgrasses has not yet been determined. We can have ice form between cells and the plants will remain alive in many instances, and fortunately ice almost never forms inside of cells which are full of carbohydrates.

Both of these theories are being evaluated at the University of Wisconsin-Madison with the intent of determining what spring conditions are necessary to cause dehardening in annual bluegrass, creeping bentgrass and perennial ryegrass. Also, when and how do our turfgrasses decide it is spring? Are there specific mechanisms within the plant we can control? The next step will be convincing the turf not to induce such mechanisms in the early spring since there are still very cold days to endure.

The Science

In order to prevent intercellular ice formation, the plants will concentrate sugars in their cells. This lowers the temperature at which the water in the cells will freeze because whenever we dissolve a solute in water we lower the freezing temperature of the solution. This seems relatively simple: lets just build up the concentrations of sugars and the cells will not freeze, right? Let's examine how this might be accomplished.

Many of us will put on a few pounds in the fall and our friends will jokingly say we are fattening up for the winter. We fatten up by eating excessive quantities of food which are converted into body fat. Well, the fat is a food reserve which may allow us to survive long periods without food. When needed, we can use up these food reserves. Believe it or not, plants behave similarly.

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Recall how plants produce their own food. The soil is important for providing nutrients, but all plants actually produce food from photosynthesis. Remember, sunlight, water and carbon dioxide convert to oxygen and sugars. When plants are growing these sugars are quickly utilized for making more plant tissue. When growth slows appreciatively in the fall at cooler temperatures, where do all of the sugars go? To storage reserves? No, plants do not get fat, but the sugars are stored in the roots and crown where they later can be used by the plant to get energy. Rather than fat, plants store up potential energy in the form of fructans. Did the sugars build up to lesson ice formation, or was this purely in response to decreased growth rates while photosynthesis was still continuing? This is another question that is being addressed at UW-Madison.

What Can We Do?

Rgardless of why plants build of sugars, we do know that we need to have sugar reserves to improve winter survival. To get more sugars we need more photosynthesis and less growth. Less growth is occurring because we are not fertilizing with water soluble fertilizers in September and October, right? More photosynthesis can only come from increasing leaf surface area (raising mowing heights) and decreasing shading. Plants actually continue photosynthesis throughout the winter, and there is not a lot we can do to increase photosynthetic rates. Therefore, we need to concentrate our efforts in reducing growth rates in the late fall and early spring.

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The late fall, dormant N fertilization that has become so popular is probably not detrimental to winter survival because the plants have stopped growing appreciatively. If nothing else, dormant N fertilization may improve the turf's recovery potential the following spring when injury occurs. My concern is that the late fall N fertilization is encouraging early spring green up which is just too early, but the effect of late fall N fertilization on dehardening has not been evaluated.

What about potassium? This is one area that has been addressed by researchers and nothing conclusive was ever found. In one study, winter injury was lessened; in the next there was no improvement. There was even one study where tissue K concentrations reached 3% of the tissue weight, but winter survival was not improved. Therefore application of K in the early fall will not worsen winter injury, but its benefit is still not proven.

Clearly we need to have a balanced fertility program throughout all year to lesson the damage from all stresses that may occur. Therefore, if soil tests indicate adequate K levels, the application of additional K is futile.

The use of synthetic covers has gained tremendous popularity for nursing sensitive grasses through low temperatures. Winter covers can help grass plants acclimate to cold by continuing the storage of photosyn-

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thates when such processes have slowed appreciatively, but the grass under covers dehardens quickly in spring due to the buffering of temperature extremes. Dehardening under synthetic covers greatly increases the moisture content of plants, making them very susceptible to damage during freeze-thaw cycles. Therefore, you can expect labor intensive application and removal of covers during the spring or else winter injury will be worse than if no covers were used.

If ice is allowed to remain on annual bluegrass for more than 60 days, turf damage can be expected. Surprisingly, some varieties of creeping bentgrass can remain alive under ice for as long as 90 days, but there are not very many pure strands of creeping bentgrass, are there? Consequently, superintendents are usually taking necessary steps to mechanically remove ice from turf as soon as possible and the removal of ice usually lessens winter injury.

In conclusion, I recommend increasing your population of creeping bentgrass or Kentucky bluegrass, maintaining moderate N levels throughout the year, improving soil infiltration rates, raising mowing heights in the fall, removing ice and stopping all traffic in order to minimize winter injury on turf. Since none of these management practices has become an acceptable method for completely preventing winter injury, synthetic turf covers are available to ensure plant survival when turf quality must be maximized the following spring. Otherwise you must plan on minimizing the turfgrass's recovery potential in the fall so that the stand will rapidly recover in the spring from any injury that occurs.

The value of such management practices are being investigated, and new management practices for insuring winter survival will soon be evaluated.