WINTER INJURY

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Winter injury and damage to turfgrass areas appears in many forms. These include desiccation, direct low temperature injury or kill (crown hydration), low temperature diseases and traffic or mechanical damage. Winter injury of turf is difficult to understand since it results from the interaction of a number of environmental factors, as well as soil and previous cultural practices. Consequently before a golf course superintendent can initiate the appropriate cultural program to prevent or minimize winter injury, he must determine the particular type or types of damage that occur most frequently at different locations throughout the golf course. This requires a study of the particular symptoms, including time of occurrence, soil type, topography, drainage characteristics, traffic patterns and the probability of climatic or environmental stress. This information is assembled over a period of several years and, as a result, a specific program can be established for each particular course in an attempt to minimize the probability of winter injury. There are many secrets to success. One secret to being successful no matter what business or profession is involved is anticipation. By anticipating the likelihood of a specific type of winter injury occurring, it is possible to initiate cultural and maintenance practices in an attempt to reduce the damage.

One of the most damaging and devastating forms of winter injury is desiccation Desiccation is of two types -- atmospheric and soil. The symptoms of atmospheric desiccation are: leaves turn distinctly white but remain erect; occurs most frequently on higher locations that are exposed to drying winds; can range from small irregular patches to extensive kill of large areas. Atmospheric desiccation occurs as a result of arid climatic conditions and high winds; in addition, soil water absorption is reduced at low temperatures or may be unavailable to the plant because the soil is frozen. Internally, the plant, as a result of desiccation, shrinks and protoplasm collapses that results in mechanical damage and death. The other type of winter desiccation is soil desiccation. The symptoms of soil desiccation occur when the leaves turn distinctly white and are semi-erect; the tissues including the crown of the plant are very dry; occurs commonly in a more extensive pattern over the turf than does atmospheric desiccation. External forces that contribute to soil desiccation include extended periods of soil drought due to a drying atmospheric environment and lack of precipitation or irrigation. Turfgrass cultural practices that minimize atmospheric desiccation include moderate nitrogen nutritional levels and the elimination of any thatch problem. For soil desiccation, in addition to utilizing moderate nitrogen fertility levels, the irrigation or hauling of water to critical turfgrass areas has been found helpful. From a soil management point of view, it has been found helpful not to core in late fall and leave the holes open. Attempts to minimize or reduce both soil and atmospheric desiccation include the use of a protective blanket, four to six mil polyethylene sheets, topdressing at the rate of .4 cubic yards per thousand square feet, using windbreaks such as snow fence or the placing of brush or pine boughs on the turfgrass area.

Another form of winter injury that frequently occurs is known as direct low temperature kill. The symptoms of the leaves of the turfgrass plant affected by direct low temperature kill appear water soaked, turning whitish-brown and progressing to a dark brown; the leaves are limp and have the tendency to form a

mat over the soil; a distinct anaerobic odor frequently occurs. Direct low temperature kill occurs most frequently in poorly drained areas such as soil depressions or where excess moisture occurs. Environmental and climatic conditions that contribute to direct low temperature kill include a decrease in temperature, particularly the adjacent soil temperature. Injury most commonly occurs at soil temperatures below twenty degrees Fahrenheit during the late winter - early spring freezing and thawing periods. Direct low temperature kill may also be associated with thawing of an ice cover that occurs from underneath. Within the plant, large ice crystals form, thereby causing mechanical destruction of the plant tissue by the frozen, brittle protoplasm. The higher the water content of the tissue, the larger the ice crystals and the more severe the damage. In an attempt to reduce direct low temperature kill and injury, it has been found helpful to use moderate nitrogen levels, increase the potassium nutritional level, increase the cutting height, reduce the thatch and avoid excessive irrigation. Also, it is important to provide rapid surface drainage by proper contours and, if necessary, removing the sod to form a trench for rapid water removal during periods of thaw or late fall rains. Coring and slicing is especially helpful when soil compaction is troublesome.

Another form of winter injury that can cause substantial damage to turfgrass areas is the activity of low temperature diseases. These include Fusarium patch, more commonly known as pink snow mold, Typhula blight, more frequently referred to as gray snow mold, winter crown rot and spring dead spot that occurs on Bermudagrass. The last one mentioned, spring dead spot on Bermudagrass, is not relevant to turfgrass management practices here in the great, grand and glorious state of Michigan. Fusarium patch or pink snow mold gets its name from the color of the mycelium that occurs on the leaves of the turfgrass plants. The disease occurs in circles of one to two inches, forming a white mycelium mass on the leaves. White to pink circular patches up to two feet in diameter frequently occur. In an attempt to reduce and minimize Fusarium patch activity, it has been found helpful to use moderate nitrogen nutritional levels and increase the potassium and iron nutritional levels. Moderate to low cutting heights as well as elimination of thatch has been found helpful. Additionally, it is important to use a preventative snow mold material in an attempt to control this turfgrass pathogen. Another low temperature disease that frequently occurs in Michigan and is troublesome is Typhula blight or gray snow mold. Typhula blight gets its common name from the light gray mycelium that occurs on the margins of the leaves as the ring advances. The whitish-gray slimy circular patches, up to two feet in diameter, are also very characteristic of gray snow mold. Frequently, brown sclerotia are imbedded in the leaves and crown of the plant ranging up to 1/8 of an inch in diameter. The cultural and maintenance practices mentioned earlier for pink snow mold are also appropriate for gray snow mold.

An unidentified low temperature basidiomycete causes winter crown rot. Winter crown rot appears as a light gray, matted mycelial growth on the leaves, with irregular shaped patches initially appearing yellow and gradually deteriorating to a straw color. Individual patches up to one foot in diameter may coalesce causing damage over a large area. Injury results from hydrogen cyanide gas produced by the saprophytic fungus; subsequently the fungus invades the host plant. The use of mercuric chloride fungicide materials has been found to be most helpful in minimizing and reducing winter crown rot.

Damage to turfgrass areas by traffic is a form of winter injury frequently experienced by golf course superintendents, managers of parks, recreational areas and other large turfgrass facilities. Damage by traffic occurs under two different types of conditions. One condition occurs on frozen turfgrass leaves; whereas, the

other occurs on wet or slush-covered turfgrass areas. The grass blades on frozen turfgrass traffic areas appear erect, in the shape of the footprint, white to light-tan in color, or in the form of wheels that have been impressed on the turf, whereas grass blades traffic damaged in a wet, slush-covered condition are initially water soaked, turning to a whitish-brown and ultimately progressing to a dark brown color. The leaves are limp and tend to form a mat over the soil. Irregular shapes associated with previous patterns of concentrated traffic appear and soil rutting may also be evident. Damage on frozen turfgrass leaves (frost) occurs when pressure of the traffic (shoes or wheels) on the rigid, frozen tissue occurs. The problem occurs most frequently during the early morning hours. Consequently, it is essential to withhold or divert traffic from frosted turfgrass areas during periods when the leaf and stem tissues are frozen. On wet and slush-covered turfgrass areas, the snow cover thaws, thereby creating a condition favorable for increased hydration of the turfgrass crowns. Traffic, including snowmobiles, force the wet slush into intimate contact with the turfgrass crowns and turfgrass loss occurs most frequently when temperatures below twenty degrees Fahrenheit occur. In an attempt to reduce and minimize damage occurring from traffic on wet, slush-covered areas, it is important that an attempt be made to minimize snowmobile, cross-country skiing or foot traffic activities, especially if a drastic freeze is anticipated. When the soil is not frozen and air temperatures are above freezing, a light application of water in the early morning can be effective for removing the frost.

PREVENTING OR MINIMIZING WINTER INJURY

Cultural and maintenance procedures can be initiated to minimize the potential for injury in the future once the cause or causes of winter damage on specific turfgrass areas has been established. The first requirement in minimizing or reducing all types of winter injury is a strong, healthy turfgrass plant with adequate carbohydrate reserves and recuperative potential. This phase of winter injury prevention is accomplished during the normal growing season, particularly in late summer to early fall. Maintenance practices to prevent or at least minimize the potential for winter injury can be classified into cultural practices, soil management practices and specific winter procedures. From a cultural and maintenance viewpoint, the proper control of plant, water and soil relations is a very critical factor affecting all phases of winter injury. Additionally, it is important to realize that the selection and planting of the appropriate turfgrass species and cultivars can be critical in minimizing the degree of turfgrass injury that may occur. Annual bluegrass (*Poa annua*) is very susceptible to all types of winter injury. The bentgrasses are more tolerant of wintertime conditions and also have a greater recuperative potential from the crown of the plant should the leaves become damaged or injured as a result of winter injury.

Remarks such as "This past winter was the worst ever and the most damaging to the golf course" is a familiar remark heard almost every spring. It may have been a familiar sound and repeated phrase in 1977-78 or 1976-77, but similar quotations can be found in many turf magazines and journals of fifteen and twenty years ago. Consequently, it can be safe to say that golf course superintendents can never feel totally at ease about their chances to avoid the ravaging and damaging effects of winter injury to the turfgrass plants. Despite the best efforts of the golf course superintendent in preparing his course for winter with the use of preventative snow mold applications, removal of ice and snow as well as mid-winter snow mold fungicide applications, some courses experience more winter injury than others. Why winter injury and turfgrass loss affects one section of the state and not another, one golf course and not the one next door or across the street, or one green and not a green a hundred yards away is very difficult to answer.

The damaging effects of winter injury can be compared to heat and skin burns. A first degree burn, such as a sunburn all over the body, is far worse and more painful than a small third degree burn on the tip of a finger. Consequently, a snow mold infestation throughout the whole golf course, including greens, tees and fairways, is more damaging than a small incidence of desiccation on the upper rear portion of a championship tee that seldom is used. Just as the human body recovers more quickly from a sunburn than it does from a third degree burn, so will the turf recover quicker from a snow mold infestation than it will from desiccation.

In an attempt to minimize and reduce the possibility against winter injury, the following suggestions are provided:

1. Provide good surface and subsurface drainage. Do not hesitate to install drain tile where needed.
2. Provide adequate, but not excessive, amounts of water for the turf and the underlying soil root zone for the late fall and winter dormancy period.
3. Do not hesitate to cultivate the soil by coring, slicing or spiking in the early fall if soil compaction has developed during the summer. Coring may also aid in improving the necessary internal drainage.
4. Raise the cutting height and cease mowing operations prior to active shoot growth. This will allow for the additional accumulation of leaf tissue that can serve as a protective insulation as well as encourage rooting and carbohydrate accumulation that is necessary for winter survival. However, do not permit excessive leaf growth to accumulate in that the possibility for snow mold disease increases.
5. It is important that excessive thatch be controlled in the fall where winter desiccation problems have occurred in the past.
6. It is important that the turfgrass plant enters the hardening off period with sufficient nutrients. Avoid excessive nitrogen fertilization during the cold hardening period when deep rooting, carbohydrate accumulation and decreased water within the plant cells should be encouraged.
7. Provide adequate potassium levels. In the past, several superintendents applied a minimum ratio of nitrogen-potassium of 2 to 1. Recently, some superintendents have been using as much potassium as nitrogen with improved results.
8. Do not hesitate to apply preventative fungicide materials for protection against low temperature disease activity.
9. In areas where desiccation and/or low temperature injury is a severe problem, do not hesitate to encourage snow accumulation with the use of snow fence, branches or pine boughs.
10. During periods of frost or warming when the snow cover is in a wet-slushy condition, followed by a subsequent severe freeze, it is important to eliminate all traffic, including foot, ski or vehicular.