WINTER INJURY CAUSES AND PREVENTION

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Most winter injury is the result of direct low temperature kill, winter desiccation, or low temperature diseases. All three major causes of winterkill can occur on either cool season or warm season turfgrass species. There are adjustments in specific cultural practices that can be made which will produce a turf having better physiological and morphological properties to survive the winter stress. Keep in mind though that even if all preventive steps are taken this will not guarantee freedom from some injury should extremely severe winter stresses occur.

Table 1. Chronology of cool season grass responses occuring as soil temperatures are lowered.

Soil Temperature (°F)	
75 to 60	Optimum shoot growth
60 to 45	Shoot growth gradually declines
45 to 35	Plant hardening to low temperature stress
35 to 32	Conditional winter dormancy
<(25 to -15)*	Low temperature kill

*Specific lethal temperature varies with species.

Winter Dormancy. Shoot growth will gradually decrease as fall soil temperatures drop. This occurs on cool season grasses in the cool climatic zone and on warm season grasses in the northern two-thirds of the warm climatic zone. Eventually, shoot growth ceases and the turf enters winter dormancy.

Cool season turfgrasses usually remain green, while warm season turfgrasses lose chlorophyll and turn tan or brown below 50°F. Cool season turfgrasses may initiate shoot growth periodically during the winter if favorable temperatures occur. This is fairly common in the southern one-third of the cool humid zone. Usually, the turf survives the winter in a dormant state and initiates new shoots and roots from crowns, rhizomes, and stolons the following spring when temperature and moisture are favorable for growth.

Low Temperature Kill. Low temperature kill involves the formation of large ice crystals in the plant that cause destruction of the delicate cellular organization. Plants containing a high water content are prone to larger, more extenisive ice crystal formation and therefore a greater chance of low temperature injury. Those cultural practices which ensure that the grass plant enters the winter without an excessive internal water content are beneficial.

The northern adaptation limits of warm season turfgrasses are controlled by low temperature kill. The northern adaptation of ryegrasses and tall fescues in the cool humid zone is also restricted by low temperature kill. Injury is

associated with ice formation within the tissue and it usually kills the plant. The turf will survive leaf and root kill. However, death of the crown and nodes on rhizomes and stolons will mean a total loss of the turf. Grass is most susceptible to low temperature kill during the late winter-early spring period.

A high water content in the tissue will increase the potential for low temperature kill. Thus, it is important to avoid areas of standing water. The best guard against kill is the use of a cold tolerant species. Cultural practices that minimize low temperature kill include (a) providing adequate surface and subsurface drainage; (b) avoiding excessive nitrogen, particularly during fall hardening; (c) ensuring high potassium levels through a fall K application; (d) avoiding excessive late fall irrigation; (e) controlling thatch; (f) raising the cutting height about one inch to provide increased insulation against low temperature extremes; and (g) cultivating to enhance soil water movement in compacted soils. Strategic placement of shrubs and/or fences to enhance snow accumulation will also protect the turf in those regions and winters when a significant snowfall occurs.

Winter Desiccation. The turfgrass will dry up during an extended winter drought. At temperatures above 32°F, the leaves are losing water to the atmosphere but the soil water is still frozen and unavailable. Even dormant, brown, warm season turfs are subject to winter desiccation. It usually occurs on elevated sites that are exposed to intense drying winds and in regions where there is little snow.

A certain degree of winter desiccation occurs on turfs every year. This results in a "wind burn" to the leaves that makes the turf brown. The brown leaves are mowed off as new growth is initiated in the spring. However, severe drought which dries out the crown and nodes of the grass plants can cause serious loss of turf.

You can prevent winter desiccation by watering the turf. Strategic placement of shrubs, trees, and fences which provide windbreaks and encourage snow accumulation also protect the turf. Cultural practices which minimize winter desiccation include (a) avoiding excessive fall nitrogen applications, (b) ensuring adequate potassium levels, and (c) controlling thatch. The use of mulches, brush, or synthetic winter protection cover could also help; especially on exposed sites that are subject to repeated winter desiccation.

Low Temperature Diseases. There are a number of diseases associated with the winter period that occur on dormant warm season grasses and semi-dormant cool season species. Perhaps the most widespread are the so-called "snow mold" diseases, although their occurrence does not necessarily require the presence of snow. Typhula blight (gray snow mold) occurs primarily in the northern third of the cool climatic zone while Fusarium patch (pink snow mold) occurs in a slightly more moderate intermediate cold zone. A third less common winter disease of the cool region is known as winter crown rot. It is caused by a unidentified low temperature basidiomycete and has occurred most commonly in the plains regions of the Canadian provinces. The main winter problem on warm season species, especially bermudagrass, is spring dead spot. It appears to be a greater problem during dry winter conditions and especially where thatch problems have developed. No reliable chemical control has been found for spring dead spot.

Heaving. Repeated freezing and thawing, which pushes plants out of their normal position in the soil and exposes roots and crowns to desiccation, is called heaving. Seedlings planted in late fall often do not root well and are particularly susceptible to heaving. The best approaches to minimize heaving are mulching and enhancing snow accumulation. Established turfs are seldom damaged by heaving, but you may need to lightly roll the area in early spring to push the

turf down into its normal position.

Ice Covers. Ice covers seldom cause injury to perennial cool season turfgrasses. Most of the damage is done when standing water surrounds the individual grass plants and then freezes. When this happens, the turf may winterkill. Unless the ice remains more than ninety days, you probably won't need to remove it. But, you should drain any excess water from the ice as it thaws.

Serious kill has occurred on wet, slushy turfs when subjected to heavy traffic followed by a freeze below 20°F. Do not allow traffic on a wet, slush covered turf.

The use of snowmobiles on turf areas creates no problem as long as there is a protective layer of snow beneath which the soil is frozen solid. Avoid snowmobile traffic on wet, slush covered turfs.

Ice Rinks on Turfs. You can make an ice rink on a turf if you use a few precautions. First, the ice rink area should be contoured so that the turf will readily drain when thawing occurs. Standing water must be avoided. Second, there should be about two inches of compacted snow between turf and ice. Also, if snow mold disease is anticipated, you should apply a preventive fungicide before the first snow.

SUMMARY GUIDELINES FOR PROTECTING AGAINST WINTER INJURY

1. Provide good surface and subsurface drainage. The latter involving primarily drain tile, where needed.
2. Ensure that the turf and underlying soil root zone contains adequate but not excessive amounts of water when entering late fall and winter dormancy.
3. If a soil compaction problem has developed during the summer, correct by soil cultivation - coring, slicing, etc. - in early fall. This will also aid in drainage.
4. Raise the cutting height and/or stop mowing prior to shoot growth stoppage in order to allow an additional insulation and enhance both rooting and carbohydrate accumulation that aid in winter survival. However, do not allow too much leaf growth to accumulate to the extent that it increases the potential for snow mold disease problems.
5. Be sure that any excessive thatch is controlled prior to entering the winter period. This is particularly important in the case of disease and winter desiccation problems.
6. Be sure that the turf enters the fall hardening period with an adequate nutritional level; but avoid nitrogen fertilization during the cold hardening period when deep rooting, carbohydrate accumulation, and decreased water content need to be encouraged.
7. Ensure that adequate potassium levels are provided. A minimum ratio of nitrogen-potassium of 2 to 1 is suggested.
8. Provide adequate preventive protection against winter disease by applying the appropriate fungicide.
9. Provide an appropriate winter protection cover where desiccation and/or low temperature kill are particularly severe problems and winter play does not occur. In some locations this may involve enhancing snow accumulation.
10. Do not allow traffic (foot, ski, or vehicular) on turfs during periods of warming when the snow is in a wet-slushy condition and a subsequent severe freeze is possible.

Table 2. Types and symptoms of winter injury that most commonly occur on turfs.

Type of Winter Injury	Symptoms
Atmospheric Desiccation	Leaves turn distinctly white but remain erect; occurs most commonly on higher locations that are more exposed to drying winds; can range from small, irregular patches to extensive kill of large areas
Direct Low Temperature Kill	Leaves initially appear water-soaked, turning whitish-brown and progressing to a dark brown; the leaves are limp and tend to lay as a mat over the soil; putrid odor is frequently evident; occurs most commonly in poorly drained areas such as soil depressions; frequently appear as large, irregular patches
Fusarium Patch (Pink Snow Mold)	Pink mycelium on leaves; 1 to 2 inch, tan, circular patches (in fall); or white mycelial mass on leaves, white to pink circular patches up to 2 feet in diameter (in winter/spring)
Typhula blight (Gray Snow Mold)	Light gray mycelium on leaves, especially at the margins of the advancing ring; whitish-gray, slimy circular patches of up to 2 feet in diameter; brown sclerotia are ranging up to 1/8 inch in diameter.

Table 3. Practices available to minimize winter injury on turfs.

Types of Winter Injury	Cultural Practices That Minimize Injury		
	Turfgrass	Soil	Specific Protectants
Desiccation	Moderate nitrogen nutritional levels Elimination of any thatch problem.	Do not core in late fall and leave the holes open.	Conwed Winter Protection Blanket Polyethylene (4-6 mil) Saran Shade Cloth (94%) Topdressing (0.4 yd^3/1,000 ft^2) Windbreaks such as snow fence, brush, or ornamental tree and shrub plantings. Natural organic mulches.
Direct Low Temperature Kills	Moderate nitrogen nutritional levels. High potassium nutritional levels. Higher cutting heights. Elimination of any thatch problem. Avoidance of excessive irrigation.	Provide rapid drainage by proper contours, catch basins, and open ditches. Adequate subsurface drainage by drain lines, soil modification with coarse textured materials, slit trenches, and dry wells. Cultivation, especially coring and slicing, when compaction is a problem.	Conwed Winter Protection Cover Soil Retention Mat Enhancing snow cover with snow fence or brush. Natural organic mulches such as straw. Soil warming by electricity.
Fusarium Patch	Moderate nitrogen nutritional levels. High potassium and iron nutritional levels. Moderate to low cutting heights. Elimination of any thatch problem.	Avoiding neutral to alkaline soil pH's.	Benomyl (Tersan 1991) Mancozeb (Fore) Thiophanate methyl (Fungo , Spot Clean) PMA Mercurous + Mercuric chloride.
Typhula Blight	Moderate nitrogen nutritional levels. Moderate to low cutting heights. Elimination of any thatch problem.	Provide good surface and subsurface drainage. Cultivate when compaction is a problem by coring or slicing.	Chloroneb (Tersan SP) PMA PMA + thiram PCNB Mercurous + Mercuric chloride