



FIGURE 1

## Winter Injury in the Cool Temperate Zone

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Desiccation and low temperature kill are the two major causes of winter injury to the turf plant in the cool temperate zone of the United States. A third type of injury caused by fungus organisms, *Typhula spp.* and *Fusarium spp.*, is prevalent from year to year, but is not as serious or as damaging as desiccation and low temperature kill. Mechanical damage, a fourth type of injury, is increasing.

### Desiccation Injury

A grass plant must rely on an internal water supply for respiratory activity. When soil moisture is limited and the internal supply of water within the plant is diminishing to a point that water loss is greater than the amount that can be taken into the root zone, the plant desiccates. This is basically a wilting phenomenon but one that is more feared than any other form of physiological winter injury.

Figure (1).

Desiccation can be held to a minimum by applying several hundred gallons of water to the area of concern before it comes under stress. Water tanks, spray equipment and the use of the watering system are tools used to obtain and disburse the water. Several applications are normally required. In the plains area of the mid-continent, it is common to have the watering system in operation during the open winter months to prevent excessive turf loss. The watering system is drained from day to day after the system has been in use. If desiccation has occurred, it is important to power spike the damaged area several times, overseed, topdress and syringe frequently to encourage germination and plant recovery. If at all possible, play should be restricted until the damaged area has recovered sufficiently to withstand traffic. However, if early play is permitted, turf re-

covery is normally slow, as a form of mechanical injury is then taking place. Soil moisture and temperature will have a direct bearing as to how early a damaged area can be played upon.

#### Low Temperature Kill

The conditions for low temperature kill to the turf plant are physiological. When the lower crown of the turf plant is in an extreme state of water content under low temperature stress, complete destruction of the plant can occur. Often the turf plant comes out of the winter looking good under these conditions. However, damage has occurred within the plant to the crown and root system which is not visible. When temperatures begin to rise in early spring to encourage growth, the plant begins to transpire and will soon die; there is no life support system functioning.

Low temperature kill has been associated with ice formation, which has been misleading. There is no question that excessive ice or snow will cause suffocation or winter scald. Suffocation will occur if an excessive amount of carbon dioxide accumulates, if oxygen is restricted, or when an interchange of soil gases is stopped. Under an anaerobic condition such as this, the solubility of excessive use of arsenicals, or heavy metals such as mercury and cadmium fungicides and perhaps other herbicides, may increase the total amount of damage. Winter scald, on the other hand, is when standing water or ice acts as a lens for the sun, which, in turn, scalds the leaf. To prevent suffocation and winter scald injury, surface and sub-surface drainage must be adequate. Breaking and removing the ice layer during the alternate

freezing and thawing period during the late winter is imperative. Figure (II).

#### Snowmold

*Typhula spp.* and *Fusarium spp.* fungi cause minimal damage to turf if normal preventive fungicide applications have been carried out. There is one exception when snowmold is in abundance during the spring of the year regardless of the preventive fungicide program practiced; that is when the ground is not completely frozen before the winter snow sets in. Snow is a tremendous insulator against cold and protects turf from desiccation. However, it increases the use of fungicides rather than limits their use. Recovery from snowmold injury to the turf plant is rather rapid if optimum spring growing conditions are present. Turf is not completely destroyed, but merely set back in a mottled state.

#### Mechanical Injury

Mechanical injury to turf takes place in two different forms; foot and vehicular traffic. With a long, late fall and early spring playing season in many areas, serious injury to turf by foot printing on frosted playing areas has become standard at many golf courses. Ice crystals within the grass blades are distorted and rupture living cells, causing death. Syringing greens in early morning, for instance, before traffic is allowed on the course, will help solve the problem; water melts the ice crystals.

During the spring when the upper portion of the soil has begun to thaw, the soil is overly wet and slippery. Foot traffic at this time will cause severe compaction and tearing of the roots at the point where they penetrate the still

FIGURE II



frozen area. When soils are partially thawed, injury is serious and long lasting. Visual damage is not noticed at this time of the season, but is one of the primary reasons why troubled areas act up during periods of summer stress.

Snowmobile damage to turf is becoming more apparent each season. A snowmobile running in loose snow will create approximately a five- to six-inch-deep track. When this area is used over and over, a glazing or icing effect takes place. Toxic conditions will develop as previously pointed out, with the end result in turf loss.

One can easily see what a golf course superintendent has to face in the cool temperate zone of the United States. Turf injury will result in many forms, in many ways, under varying conditions. It is not an easy task to provide optimum playing conditions when the breaks are not going your way. The golfing membership plays in late fall or early spring and often refuses to remain off the frozen turf. Construction to improve drainage or rebuild a new green is not carried out because of the late playing season. The ground is not frozen solid going into the winter months, an early snow falls and preventive fungicides have not been applied for snowmold control. To top it off, the snowmobiles have an early start this winter. With spring around the corner, anaerobic conditions have been created with an abnormal amount of snow. Ice and snow removal has been taking place in order to correct existing conditions. And, as the remaining ice and snow melts, low temperature kill has occurred with a healthy looking plant on the playing surface. Snowmold is scattered hither and yon, and the northwesterly winds are just beginning to let you know that desiccation may still be a problem this early spring.

Yes, here comes the golfer, the snowmobile has been put away and he can't understand why the course is the way it is. Under these conditions one must expect turf loss.

### Conclusion

What steps then should be taken by golf course superintendents to prevent winter injury? The first and most important rule is not to play on turf when it is not actively growing, especially greens. Temporary greens should be played from the time the ground begins to freeze in late fall until completion of heaving and thawing in early spring. Excerpts from "The Case For Temporary Greens," January, 1966, USGA Green Section Record, document the importance of remaining off turf during this stress period:

"So many more golfers play each course now in regular season that injury due to the

increased traffic is mounting and off-season play can only add to the total traffic injury problems.

"In late fall or early winter when frost enters the ground, turf becomes frozen and the upper fraction of soil becomes moistened with frost. Traffic at these times will break or crack the stiff and frozen blades of grass, weaken them, and *Poa annua* or other weeds could subsequently encroach, and so the turf is generally weakened. Traffic imposed upon moistened soil results in a cementing of the soil due to the lubricating action of the moisture. This undoubtedly adds to compaction.

"In winter when the ground is frozen solid, turf blades would suffer only if play were allowed while the grass, too, was frozen. The danger here is that during the day while players are on the course, sufficient thawing could occur in the upper fraction of soil to cause footprints and a cementing action of the soil. This occurs when air temperatures are higher than normal and, of course, these are the very days when golfers prefer to play.

"The most difficult time for turf is in late winter and early spring, from mid-February through March when the top one inch of soil (or less) is thawing but the soil beneath is frozen. Traffic on greens at this time will result in severe compaction.

"Any time water stands on a green in winter, no play should be allowed. This results in extreme softness of the upper fraction of soil and turf.

"All told, any amount of play in winter generally means more rigid management during the growing season, especially more aeration and more topdressing to true and level greens. If play is allowed on regular greens, we cannot stress too vigorously that the days must be very carefully chosen; that someone must make these day-to-day decisions; and that your course must be treated as an individual problem. It should not be kept open or closed simply because a nearby course is open or closed.

"The only way to insure against possible trouble is to have temporary greens. It has often been suggested that the word 'alternate' be used in place of 'temporary,' because the latter bears a negative connotation."

Second, drainage conditions must be at an optimum if sound turf programs are to be carried out and followed to prevent winter injury. And, third, an adequate budget, good source of labor and communication between the golf course superintendent and his immediate superior must become a reality when facing the winter injury problem in the cool temperate zone of the United States.