With care, heavy equipment can be used to remove ice and snow when greens are frozen.

Putting Greens: Dealing with Snow and Ice Accumulations

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WINTER INJURY IS among the more frustrating types of damage a golf course can experience, particularly when it is associated with snow and ice cover not only on greens, but also on other areas. At least other types of turf problems result from controllable or preventable causes to some extent, like diseases, insects, wilting, poor drainage, or compaction and wear from heavy traffic. Even other kinds of winter injury, such as desiccation, winter diseases, and winter traffic effects, usually can be explained, if not always easily prevented.

For the golf course superintendent, injury caused by snow and ice accumulation is a problem in a class by itself. Winter damage is impossible to predict; if turf is lost, the superintendent can be in a precarious situation with club officials because so little is known about the nature of the injury. Even though criticism often is unjustified, it's no wonder that club officials sometimes become suspicious about the superintendent's ability to deal with winter injury. The fact is that there are many questions which remain unanswered.

There remains much confusion concerning the actual mechanism of turfgrass kill associated with snow and ice accumulations. A number of theories have been proposed, and some of them are contradictory. One theory popular

When ice and snow are carefully removed, the turf comes through much sooner.

in the 1960s suggested that turf died from suffocation caused by the buildup of respiratory carbon dioxide gas under the ice sheets. This idea has been challenged by Dr. James B. Beard, of Texas A&M University. His studies indicate that this type of injury rarely occurs. Some authors proposed that winter scald is part of the problem, caused by a lens effect when sunlight passes through ice or standing water, thus scalding the leaf. Others have suggested that the solubility of arsenical, mercury, cadmium and other compounds increases under anaerobic conditions and contributes to turf losses. In an article appearing in the November, 1972, issue of the USGA GREEN SECTION RECORD, Dr. Beard stated that, "The winter injury most commonly associated with extended periods of ice coverage occurs during freezing or thawing periods when standing water increases the crown tissue hydration and subsequent injury of the turfgrass plants when temperatures drop rapidly below 20° F."

Most researchers and observers agree about two things, however:

1) Greens with poor surface and internal drainage are more susceptible to this type of winter injury than well-drained greens, and

2) *Poa annua* is much more likely to succumb to winter injury than any of the bentgrasses.

Therefore, providing good drainage and developing strong stands of bentgrass should be the goals of every course which suffers regularly from winter injury.

A QUESTION that requires a good deal of judgement and experience is when to begin to remove ice and snow accumulations from the greens. Whether or not even to attempt to do this could be argued, but research and field experience have shown that ice removal is worth the effort if the accumulations have persisted for a prolonged period.

Turfgrasses can withstand various periods of continuous ice coverage without significant damage, from 60 days for annual bluegrass to 150 days for Toronto creeping bentgrass. Generally speaking, however, bentgrasses are quite tolerant of ice coverage. Annual bluegrass, on the other hand, is readily susceptible to ice injury, while the Kentucky bluegrasses fall somewhere in the middle. When to begin to remove the ice from greens or tees, therefore, will depend greatly upon the species composition of the underlying turf. Ice removal should begin 50 to 60 days after an ice cover has been established on greens composed primarily of *Poa annua*, whereas removal need not be started for 100 days on predominantly bentgrass greens. Regardless of the number of days it has been since a solid ice cover has been established, however, ice and snow should be removed from any green with characteristically poor surface drainage just prior to an anticipated thaw. Snow melts during a thaw, and water accumulates in the low, poorly drained pockets on the green. A sharp drop in temperature may then kill the turf in these pockets, so the advantages of removing the snow before the thaw are quite obvious. All the ice and snow should be removed except for perhaps half an inch to an inch, which will protect the turf from desiccation and low temperature extremes.

It's easy enough to recommend snow and ice removal after a certain period of time or just before a thaw, but anyone who has tried it knows that it is very difficult. Access to the far reaches of the golf course with equipment and materials during winter may be impossible, and in winter the size of the maintenance crew is usually small. This

often leaves the superintendent with no choice except to clear just a few of the greens, those with the worst problems or easiest access.

As an alternative to complete clearing, trenches can be dug through the snow and ice in the low areas of the remaining greens, thereby providing a drainage pathway for excess water. If ice removal or trenching cannot be done, it could be of some benefit to break up ice sheets with sledge hammers and picks. This should at least cause the ice to melt faster. Where weather conditions make mid-winter clearing work difficult or impossible, a sod strip is sometimes taken in the green during late fall. A neat drainage trench can be easily dug in the green simply by using a sodcutter to remove the sod. The sod can then be entrenched in a sand bunker to preserve it over the winter, and it can be replaced safely the following spring. Unfortunately, this technique produces only variable results and leaves a visible scar which remains for most of the golf season.

IT IS UNLIKELY THAT two superintendents will agree completely on the best method of snow and ice removal. Some are very successful in using bulldozers or front-end loaders on their greens. This can be a risky operation, though. Care must be taken not to come too close to the turf surface, especially on greens with prominent undulations and contours. Others use picks and shovels for snow and ice removal, but this is time-consuming, and it obviously limits the number of greens which can be cleared or trenched. The use of machinery on the greens in late winter will depend to some extent upon the depth of frost in the soil.

Another good technique is to apply a dark-colored material to the surface of the snow and let the sun's energy do the work. The dark material absorbs the incoming radiation and causes the snow beneath to melt faster. This method takes longer to work, but is often very effective. Topdressing is often used for this purpose, sometimes mixed with activated charcoal, soot, or fertilizer. A rate of about two cubic yards to 5,000 square feet can be applied. This method has other advantages. Once the topdressing has reached the turf surface, it provides protection from subsequent desiccation weather. Dark-colored organic fertilizers are also popular topdressing materials; they can be quite effective when used at a rate of about 20 pounds of material per 1,000 square feet.

An intriguing idea which may be worth trying is to apply a good wetting agent to the surface of the snow to promote faster melting. A thick film of water tends to develop at the surface and delays the melting process. Applying a wetting agent reduces surface tension and encourages water movement down through the snow, thus promoting faster melting. It is often impossible to apply a sprayable material during the winter, but with the advent of the new granular wetting agent formulations, this idea may be more feasible. Using the granular wetting agent in conjunction with a dark-colored topdressing material, enabling you to pre-mix these materials, is a convenient way to get the best from both of these programs.

On greens where a history of winter injury is apparent, snow and ice should be removed during late winter. A number of techniques can be employed to reduce the potential for winter injury, but none can guarantee complete success. The wrong sequence of weather conditions may produce extensive turf losses on golf courses in local or wide regional areas, despite precautions.