

grommets fastened along the cover's edge at 24" intervals. Large 12"-long spikes are fastened through the grommets and the covers, which are left in place through winter.

Removing the covers and the straw is the most labor-intensive aspect of the operation. Nearly 600 hours of labor were required last season to remove and dispose of the straw at Mt. Bruno Country Club. The covers and straw are removed in late winter or very early spring. The straw can be pushed off the green manually or with a small tractor equipped with a straight blade. The turf may be chlorotic initially, but it soon recovers after exposure to the sun. The straw debris is stockpiled in an adjacent rough or greenside bunker, where it can be removed at a later date.

As with any covering technique, care must be taken to avoid scalping injury and possible frost damage to the succulent turf after the covers are removed. Therefore it is important to keep the permeable covers at hand so they can be reinstalled if necessary. A fungicide application also is highly recommended immediately following the removal of the covers to extend protection against snow mold diseases.

The primary disadvantages with the straw covering system include labor and material costs, and possible disease injury. Costs for this technique range from \$18,000 to \$19,000. The cost of covering 19 greens at Mt. Bruno Country Club was approximately \$19,000 (not including covers), but the costs will probably lower as application and re-

moval techniques are refined. Ask Mr. Brown or Mr. DuFresne if the covering technique is worth it, and their answer is a resounding "Yes." The greens are playable four to six weeks earlier in spring, and the turf is stronger for the upcoming season.

Is this covering technique for you? That is a decision only you and your course officials can make. Ideally, problems of inadequate surface and internal drainage and poor growing environments should be addressed to provide a long-term solution to the ice problem. However, the straw cover technique provides a viable option, especially for those few problem greens prone to crown hydration injury. The technique's costs will quickly be forgotten when golfers can better enjoy greens free of winter injury.

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# HAVE AN "ICE" DAY

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**W**INTERKILL of turf in low-lying, poorly drained areas of the golf course is an annual concern of many superintendents located in the northern tier of states and Canada. Crown hydration is considered to cause the most serious losses of turf, but the injury that occurs under prolonged periods of ice cover and, to a lesser extent, wind desiccation, can also cause significant damage.

Ensuring adequate surface drainage is one good defense against crown hydration and ice injury. Eliminate or minimize water-holding hollows/swales on the golf course and there simply is little potential for standing water to cause problems during the winter. The time to design an appropriate amount of drainage into the course is during construction. Once the course is in play, altering surface drainage patterns involves a considerable amount of inconvenience to golfers. The installation of subsurface drain tile, sumps, and surface drains will facilitate the rapid removal of excess water from the course during spring through fall, but subsurface drainage is practically useless when the ground is frozen.

Even where adequate surface drainage exists, the right combination of weather conditions during winter can turn portions of

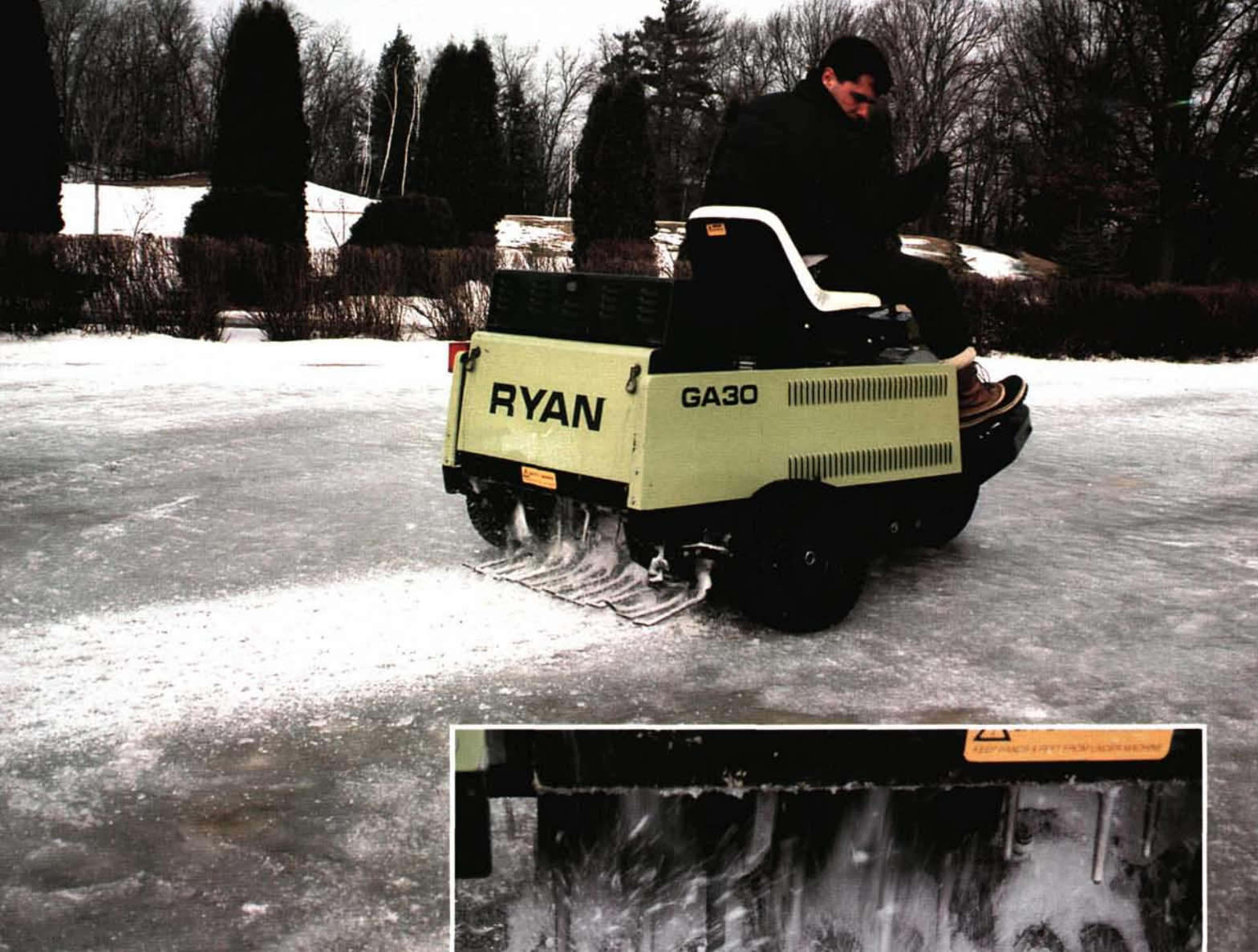
the golf course, especially greens, into ice skating rinks. Just how long cool-season turf can survive under ice cover is not well understood. Very little research has been undertaken regarding ice damage, and the most widely accepted study, by Dr. James B. Beard, was done almost 30 years ago (Beard, J. B. 1969. Winter Injury of Turf-grasses. Proc. 1st Inter. Turf. Res. Conf. 1:226-234). He concluded that turf can survive under ice for 50 to 60 days and that *Poa annua* will be the first species to winter-kill. Recent research by Dr. John Roberts at the University of New Hampshire suggests that the length of time turf can survive under ice can vary significantly, depending on the quality of ice (clear or cloudy), the presence of snow cover, the physiological condition of the turf just before freezing, and many other factors.

Enough of theories. Let's say that several of your greens have been covered with 6-8" of ice for about two months with no thaw in sight. What are the options for ice removal? Some superintendents have spread "darkening agents" such as Milorganite, charcoal, soot, or other materials over greens to collect the heat from sunlight and melt the ice. The results range from complete success to little effect. Obviously, darkening agents depend

upon sunlight, something that can be in very short supply during winter in many parts of the country.

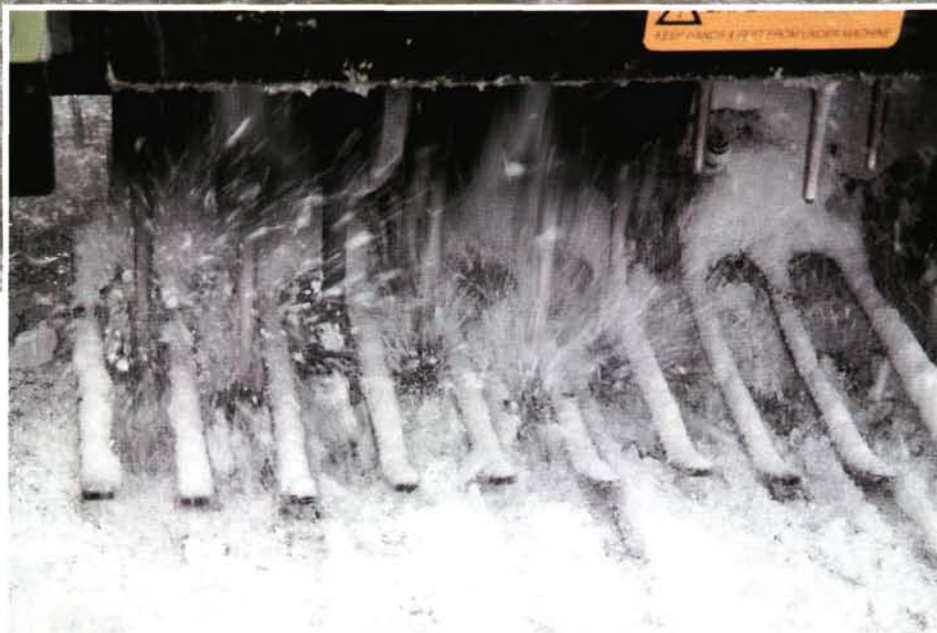
Physical removal of snow and ice from greens has been attempted at many courses with varying degrees of success. The following "recipe" for ice removal comes courtesy of Randy Witt, CGCS, of the Oneida Golf and Riding Club, Green Bay, Wisconsin. He has fine-tuned a technique for eliminating thick ice from greens through trial and error. He utilizes a Ryan GA-30 aerator and a Turf Cat 72-inch rotary mower equipped with a sweeper.

First of all, *use common sense*. Operating any equipment on a slick, ice-covered green can be risky, especially on a severely contoured putting surface. This technique is best suited for relatively flat greens. The GA-30 travels forward on ice surprisingly well, but it is nearly impossible to operate in reverse, so plan your pattern of travel across the green accordingly. Mr. Witt uses homemade, blunt-tip, 5/8-inch-diameter solid tines on thick ice cover. The tines are cut from a length of 3/8-inch rolled steel rod. Standard 1/2-inch-diameter solid tines have relatively sharp points and are used after most of the ice has been removed or on thin ice covers. The smaller, sharper tines are used to minimize



(Above) A Ryan GA-30 aerator equipped with  $\frac{1}{2}$ "- or  $\frac{3}{8}$ "-diameter solid tines is used to carefully remove thick ice cover from the putting surface.

(Right) When the depth of penetration is set to about  $\frac{1}{2}$ ", the tines cleanly shatter the ice. When set deeper, substantial damage to the tines, tine holders, and aerator will occur.



damage to the frozen putting surface and the geotextile fabric covers that are used to protect the greens from wind desiccation.

The key to success is to be patient and not become greedy. It's cold, but trying to remove an inch or two of ice with each pass of the aerator will only result in broken tines/tine-holders and serious damage to the equipment. Adjust the depth of penetration to *remove not more than  $\frac{1}{2}$  inch of ice at a time*; then make multiple passes at right angles to the previous pass until the ice is

shattered. The first pass or two may only dimple the surface, but subsequent passes will have greater effect. The sweeper is used to remove loose ice after every few passes. It can also be used to remove snow cover before ice removal, if necessary.

Another tip is to remove ice during the colder early morning hours. The ice is brittle and more easily shattered at low temperatures. By mid-morning on a sunny day, the surface ice may be too soft for this technique.

In summary, it may not always be necessary or advisable to remove ice from greens. Many factors must be considered: how long the ice has been present, the potential for wind desiccation if the ice is removed, the condition of the turf during ice formation, the percentage of *Poa annua*, etc. Once the decision is made to remove ice, though, careful use of an aerator can produce excellent results if patience and common sense are used. The key to success — only remove a little ice with any one pass of the equipment.