Winter Protection of Annual Bluegrass Golf Greens

How protective covers can reduce winter damage to putting greens.

by JULIE DIONNE

THE QUALITY of putting surfaces is one of the most important criteria by which golf courses are evaluated. Extensive winter-kill on annual bluegrass golf greens is a major concern in Canada and the northern United States, where damage can disrupt play for many weeks in the spring and result in significant losses of income. Winter damage is caused by a wide range of environmental stresses, including rapid exposure to cold temperatures, prolonged exposure to cold temperatures, desiccation, freeze-thaw cycles, extended snow cover, ice encasement, and disease.

Golf course superintendents utilize various types of protective covers to reduce winter damage to putting greens. The covers can be invaluable tools for protecting golf greens against freezing temperatures, ice encasement, and desiccation injury. There is a wide array of winter covers available for use. However, many superintendents report inconsistent results with the use of the protective covers, and there are few precise recommendations for their use and almost no data comparing their effectiveness in northern climates.

The Horticultural Research Center of Laval University, Quebec City, established a research program to answer some of these questions. The Canadian Turfgrass Research Foundation provided funding for the project. The project's objectives were to evaluate the effectiveness of different winter covers and develop improved protection practices for annual bluegrass golf greens.

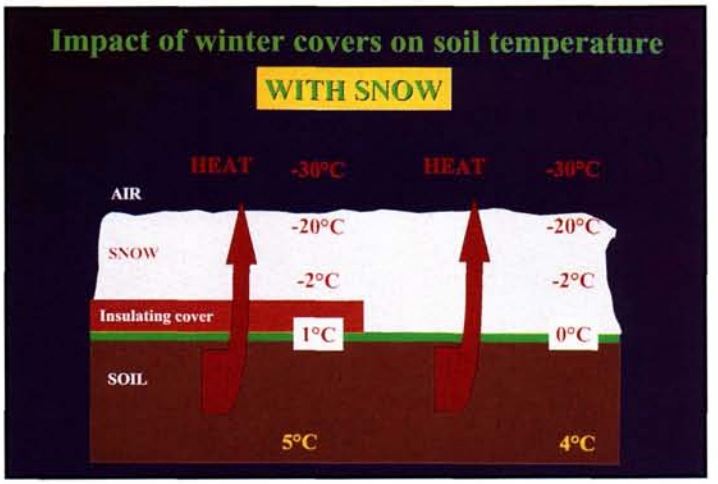
Research Methods

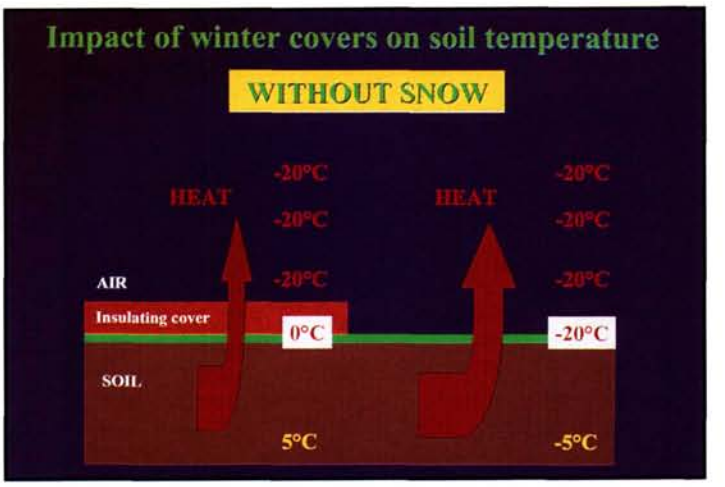
The study was conducted over a seven-year period at Laval University's experimental green located in Quebec City and on greens at Montreal Country Club, Royal Montreal Country Club, and Royal Quebec Country Club. The golf courses were selected in part because of the wide variation in winter climates between sites. The principal objective of this research was to evaluate the impact of different winter protective covers on soil temperature and on winter survival of annual bluegrass on golf greens.

During the winter of 1994-95, eight different winter protection treatments were tested. Covering systems with different permeability and insulating characteristics were selected. The protection systems in the project included:

- Permeable covers
- Impermeable covers (Evergreen brand covers from Hinspergers Poly Industries Ltd.)
- A curled wood shavings mat (American Excelsior Company) protected with an impermeable cover
- A straw mulch system (consisting of a permeable cover with 15cm

Research plots at Montreal Country Club seven days after the winter protection covers were removed. The type of cover used had a significant influence on soil temperatures and turf injury under severe winter conditions.





of straw covered by an impermeable cover)
- A 3mm felt material (Texel Incorporated) protected by an impermeable cover
- A 10mm felt material (Texel Incorporated) protected by an impermeable cover
- A 5cm air space (created with a wooden frame covered with an impermeable cover)
- A non-protected control treatment

In 1994, winter covers were installed on 3m-by-3m plots on November 24, prior to the first snow cover at Laval University and on November 30 at the Montreal Country Club. A fungicide and rodent repellent were applied before the covers were installed. Winter protective covers were removed on April 7 at Laval University and on March 21 at the Montreal Country Club. Soil temperatures under the covers and climatological data, including air temperature, thickness of snow cover, rainfall, and snowfall, were recorded daily during the winter. Annual bluegrass quality and recovery in the spring were also evaluated.

Soil Temperatures and Turfgrass Winter Survival

Soil temperature is more critical than air temperature for the winter survival of annual bluegrass. Temperatures in the surface soil affect the crown portion of the plant. Surface soil temperature is also a determinant in turfgrass disease development. Winter air temperatures in both Quebec City and Montreal often reach values of -30°C (-22°F). Annual bluegrass cannot tolerate exposure to such low temperatures, and its winter survival is linked to the insulating protection of snow or artificial covers.

Effects of Deep Snow Cover

Snow cover was deep and lasting at the Quebec City plots. Soil temperatures remained around 0°C (32°F) throughout the winter season under the different protective covers and on uncovered control plots. The thick and continuous snow cover was a very good natural insulating material and prevented soil temperatures that could be fatal to the turf. However, the deep snow cover and constant soil temperature also were favorable for snow mold diseases. Consequently, most winter damage observed on the experimental golf green at Quebec City was caused by snow mold rather than by freezing temperatures. These results emphasize the importance of disease management and appropriate use of fungicides prior to installing the covers.

Effects of Intermittent Snow Cover

In contrast to the Quebec City experimental site, the plots at Montreal Country Club had thin snow cover, and, as a result, the soil temperatures were lower, even though air temperatures at the sites were similar. In addition, high rainfall completely melted the snow cover in December 1994 and January 1995. The type of cover used had a significant influence on soil temperatures and the resulting turf injury under these severe winter conditions.

Insulating covers like straw, the curled wood mat, and the 5 cm air space reduced soil temperature fluctuations at the crown level, minimizing the impact of freezing air temperatures and thin snow cover. Minimum soil temperatures at the crown level were recorded at -1°C (30°F) under straw, -2°C (28°F) under curled wood mat, and -6°C (21°F) under the air space. Straw, the curled wood mat, and the 5 cm air space provided adequate insulation, and the annual bluegrass overwintered successfully. Turf quality was excellent immediately upon removal of the straw and curled wood mat covers. Minor damage was observed under the cover that provided the 5 cm air space, but the turf was fully recovered within two weeks following the removal of the covers.

The thick felt material (10mm) cover did not provide as much insulation as straw, the curled wood mat, or air space treatments. The soil temperature at crown level under the felt dropped to a minimum of -10°C (14°F) and considerable winter damage was observed on turf under those covers. Recovery was complete and turf quality was excellent on April 26, more than a month after winter protection removal.

Very cold minimum soil temperatures were recorded under the thin felt material (3mm) covers, permeable and impermeable covers used alone, and on turf without protection. Minimum soil temperature at crown level reached -15°C (5°F) under permeable and impermeable covers and -17°C (1°F) under thin felt material covers and on the uncovered control plots. The cold soil temperatures at the plant crowns and the large temperature variations were responsible for the severe damage observed for the four treatments.

Annual bluegrass under thin felt material, permeable and impermeable covers, and on the uncovered control plots was entirely dead following the removal of the covers. Spring recovery eventually resulted from germination of annual bluegrass seed present in the green soil seed bank.

Annual bluegrass seedlings were apparent on damaged plots in mid-April, and turfgrass quality improved as annual bluegrass growth progressed. Spring turfgrass quality on control plots and under thin felt material, permeable,

and impermeable covers remained significantly inferior to that observed under the better-insulating covers for several weeks following the removal of the covers. Annual bluegrass on these severely damaged plots was not suitable for play until May 17, about one month following the Montreal Country Club golf course opening (April 16). From the level of damage observed on these plots and from other winter protection experiments, we have determined that a critical minimum crown level temperature of -10°C (14°F) is required to damage annual bluegrass greens.

Practical Steps For Winter Protection

The use of insulating winter protective covers improved turfgrass quality and surface conditions earlier in the spring in our tests. That may be good news for golf course superintendents and for golfers in northern climates. There are some practical steps for optimizing the winter protection of your golf greens:

- A preventive fungicide for snow mold disease control must be applied before the installation of winter protective covers. Temperature and moisture conditions under covers are very favorable for disease activity, and fungicide protection is therefore imperative.
- Consider local winter conditions and snow cover. It is not necessary to use a heavy insulating material if snow cover is deep and continuous. However, if snow cover is thin, the use of insulating protective covers is highly recommended. They decrease temperature fluctuations at crown level and minimize the impact of freezing temperatures.
- Always use impermeable protective covers to keep the insulating material dry and reduce injury from ice encasement and crown hydration.
- Monitor the temperature profile under winter protective covers. Temperature provides information on the modifications of the insulating properties of the covers and will be helpful for determining when to remove the covers in spring.
- Install and remove the winter protective covers at the right time. Installing covers too early may interfere with hardening of the plant and lead to excessively warm temperatures under the covers. It is important to install covers as late as possible in fall, ideally after the plant has hardened off. Removing covers too early in the spring can expose turf to frost damage and desiccating winds, while late removal could result in snow mold damage because fungicide effectiveness is low at the end of winter.
- Spring permeable covers should be used after the winter protective covers have been removed. These light cover materials provide protection against late frosts and desiccation.
- Winter protective covers are a valuable tool for preventing winterkill of annual bluegrass golf greens. However, the covers will be most successful when used together with a sound turfgrass management plan. Proper mowing practices and a sound fall fertilization program are very important to maximize energy reserves and optimize cold hardening of turf, and consequently improve winter survival of annual bluegrass golf greens. Turf growing in full sun also will reach a greater degree of cold temperature hardiness.

Current Research Programs

The first series of experiments confirmed that winter protective covers are an effective and practical way to mitigate winter damage on annual bluegrass golf greens in northern climates. Additional trials to look at different insulating materials and covering systems also are required. We currently are working on atmospheric composition under winter protective covers, particularly under impermeable covers. These covers are very effective in preventing excess water at the plant crown level and keeping insulating materials dry, thereby increasing plant tolerance to winter stresses. However, annual bluegrass winter damage not related to low temperatures has been observed under impermeable covers on certain golf greens. It is hypothesized that this damage may result from the modification of the atmosphere at the plant level due to the presence of the covers.

We have recently documented that CO_2 concentration under covers increases as a result of oxygen consumption, exposing plants to anoxic conditions for long periods of time during winter. The objectives of our ongoing research on winter protection are to identify soil and/or plant factors associated with the occurrence of anoxia under winter protective covers, and to evaluate passive or forced ventilation systems for reducing anoxic conditions and toxic gases on recurrent winter-damaged annual bluegrass golf greens.

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This research is funded by the Canadian Turfgrass Research Foundation

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