WINTER PROTECTIVE COVERS

Usage of wraps to improve winter survival of golf greens

Introduction

Some greenkeepers regularly cover their greens to prevent winter injuries. They experience good results and find that their effort payback. The arguments for the covering practice differ, though. Some will protect the grass from lethal freezing temperature. Some will prevent desiccation while others claim that covers reduce the risk of water and ice injuries.
This fact sheet will discuss what kind of protective covers can be used to address different winter stresses based on research and published reports.

Summary

- Covering golf greens to protect them from winter injuries is expensive but can be very efficient where winter conditions are tough. Annual meadow grass benefits from covers much more than other grass species because it is very vulnerable to all kind of winter stresses.
- The covering materials and techniques should be adapted to the expected stress factor. If low temperature is causing winter kill, insulation materials must be used. If ice encasement or melting water is the problem, an impermeable tarp can keep the soil pores filled with sufficient air to prevent anoxia.
- All covers will increase the risk of winter disease and use of fungicides is a prerequisite for success.

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Special fabric creating an 18 mm air filled space between plastic and turf is being removed from a full scale experiment on Miklagard golf course, Norway. To the left is a semi-permeable tarp. The right part was covered with plastic only. Photo: Stefan Schön.

Definitions

Winter covers are used to protect from abiotic injuries caused by tough climatic conditions. Spring covers are primarily used to accelerate grass growth in spring, but they can also protect the grass from stresses caused by high radiation, low temperatures or drought.

Snow cover can form excellent protection from many stresses while ice cover can be very harmful. In this fact sheet we define 'winter protective covers' as materials that placed are on the turf by the greenkeeper staff before winter and normally kept there until spring comes.

Tarp materials

Impermeable covers keep water out and prevent gas diffusion. Inexpensive plastic, transparent or white, is good enough where the risks of damage from animals or cross country skiers are low. More persistent fabric with rubber or plastic impregnation is the alternative.

Semi-permeable covers will allow gas diffusion but prevent water movements. We know these products from relatively expensive shoes and clothing, but tarps with these characteristics are also on the market for an acceptable price.

Insulation materials have high resistance to energy transport (low k value). They normally contain air in small pores. Wind can reduce the insulation effect. The most common insulation materials are therefore used in combination with tarps that prevent water intrusion or air movements.

Bubble plastic has been used in some experiments. Because the pores are big, the insulation value is low, and it should be recognized as a double layer of plastic than as an insulation material.

Some special fabrics are open for diffusion and contain large pores that will not insulate because of free air movement. They have been used in experiments to increase the air reservoir under an impermeable cover.

Grass species and covering strategy

The turf grass species' winter stress tolerances differ a lot. Annual meadow grass (*Poa annua*) is far less resistant to all kinds of winter stress than other cool-season grasses commonly used on greens. More information can be found in the fact sheet "Grass species and varieties for severe winter climates".

This knowledge is very important when comparing reports or discussing experiences with other golf course managers. Some old golf greens have a mix of many previously seeded species. In the Nordic countries many courses are sown with a blend of red fescue (*Festuca rubra*) and colonial bent (*Agrostis capillaris*) and the dominating species varies from one green to another. Mapping of the botanical composition of the greens is very useful before discussing covering strategies with other golf course managers or suppliers of winter tarps.

Why winter covers?

Reports from experiments with covers use different arguments when they introduce their experiments.

Canadian researchers have been focusing on the insulating effects of the covers because annual meadow grass greens rarely survive temperatures below -12 ˚C in nature. They have monitored temperature fluctuations under different materials, including straw. Because insulating materials must be kept dry under an impermeable tarp, they have also monitored the oxygen concentration under covers, and tested ventilation systems for covered golf greens. Their research has been related to winters with insufficient snow cover when the plants are exposed to freezing temperatures and desiccation from wind and sun radiation. This reflects the winter conditions for many golf courses in Canada.

Successful winter cover in Canada. Photo: Jim Ross.

The Nordic capitals are situated about 15˚ north of Toronto and Quebec and the snow covers in these areas could last for 4-5 months. But the mild Gulf Stream causes the winter temperatures to fluctuate and warms spells with rain makes ice encasement the most severe winter stress on golf courses in this area. This ice often builds up under the snow where melting water meets the frozen ground. The grass is killed by anoxia when ice fills all pores in the soil. Impermeable covers prevent water intrusion to the greens, and this is the main reason why a few golf courses in some parts of the Nordic countries. (3% in Sweden and less in the other countries) regularly use winter cover on their greens.

Ventilation systems have been tested in Canada. Photo: Jim Ross.

Harmful effects of covers

Fungi causing winter disease (snow moulds) thrive under humid, but not wet, conditions when temperatures are close to 0 ˚C. Winter covers may cause a perfect environment for disease development, and all reports conclude that winter covers should be used in combination with an effective fungicide program.

Impermeable covers will prevent gas diffusion between the root zone and the atmosphere. Micro-organisms in the soil and the grass plants themselves use oxygen for respiration during the winter. Their respiration rate is related to temperature and the number of microbes is related to the organic matter content in the green. Compacted greens, USGA greens with a high content of organic matter in the root zone at construction (more than 2.5% by weight) or greens with a pronounced thatch layer - are risky. They should not be covered without a system for ventilation. It has been suggested that the critical level of oxygen is about 8%.

Under impermeable covers we often find some ice. This can be ice crystals or a thin ice layer which is formed when vapour in the soil air freezes on the cold surface of the tarp. We have not seen any damage from this ice.

Monitoring gas under covers

In the atmosphere the oxygen (O_2) and carbon dioxide (CO_2) equals about 20 % of the air. The major component is nitrogen.

In soil or under tarps the relative humidity is 100% and the water molecules also occupy some of the space, so the sum of CO_2 and O_2 is about 15%.

Meters for monitoring both CO_2 and O_2 are more expensive than CO_2-devices, and it is sufficient to measure only the CO_2 levels. If the CO_2 level increase above 8% it is time to take action, if the temperature is higher than -2˚C under the cover. Minus two seems to be the temperature where respiration starts and oxygen level decreases.

Costs

The price for the covering materials varies from very cheap plastic to advanced multi-layer systems that can be tailor-made for each individual green. If monitors and ventilators are added, the material cost can be very high.

When the aim is to prevent water intrusion, the covers must be dug into the ground around the green. This is labour-intensive in the autumn and in the spring. Some golf courses find it very costly to prolong the employment of seasonal workers until the optimal time for covering. The optimal time gap is often very short and the work should be done in a few days, preferably after the first frost, when the green is dry and when the weather forecast predicts that winter is arriving.

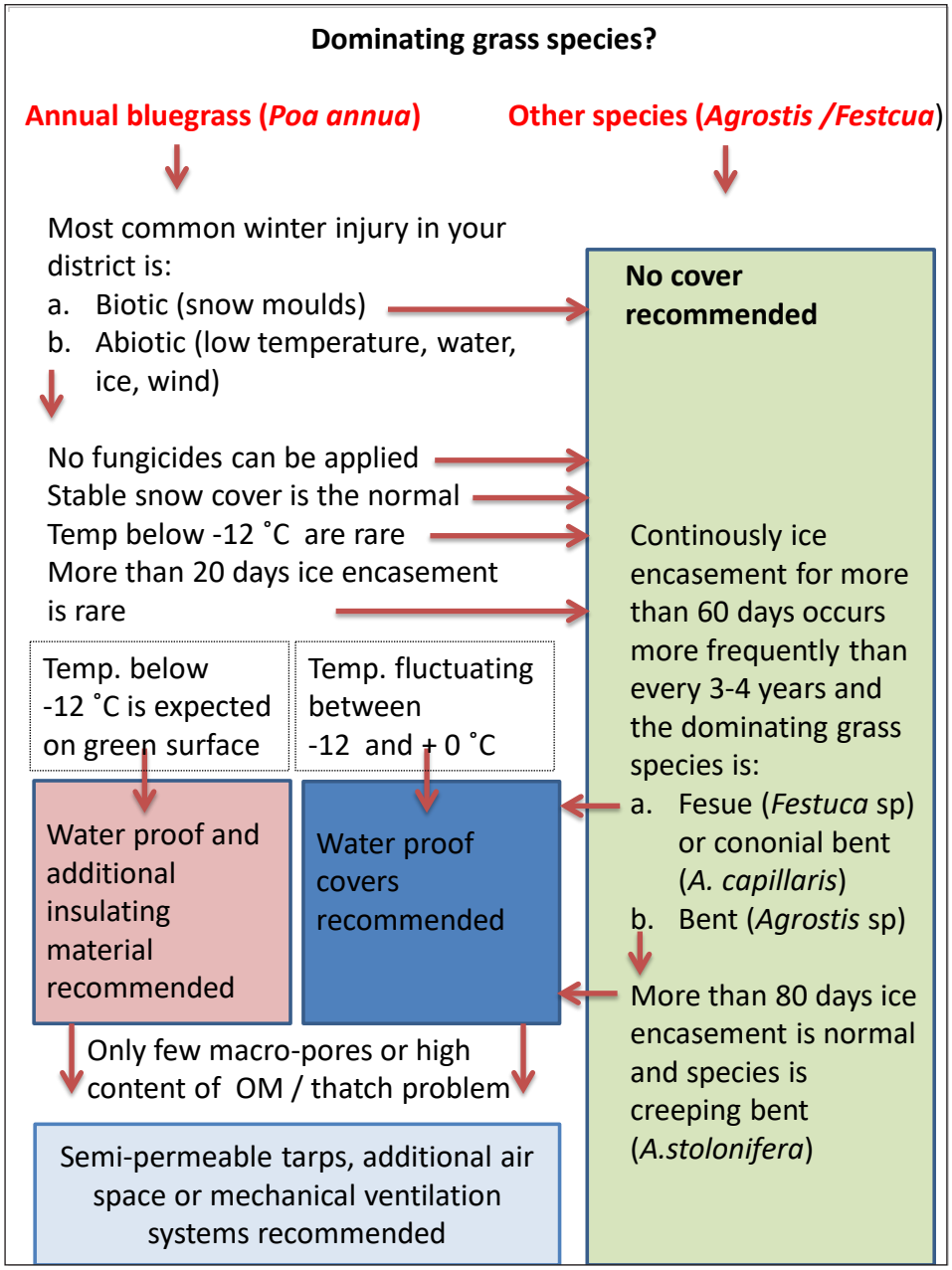
Insulating covers are voluminous and most of them need to be stored in a dry place. Housing adds costs to the covering practice.

The cost – benefit analyses are difficult because it also includes the market situation for the golf course. In some districts the playing conditions in the early spring is a key factor to attract members and green fee guests.

Plastic is dug down all around the green and the edge sealed with sod from a turf cutter. This is necessary to prevent water intrusion under the covers. Photo: A. Kvalbein

Recommendations

Based on the currently available reports we have drawn a chart that can be useful support tool when making a decision.



Written by

Agnar Kvalbein
Agnar.Kvalbein@nibio.no

Tatsiana Espevig
tanja.espevig@nibio.no

Wendy Waalen
wendy.waalen@nibio.no

Trygve S Aamlid
trygve.aamlid@nibio.no

NIBIO Turfgrass Research Group, Norwegian Institute for Bioeconomy Research

Read more

Pam Charbonneau: From root to Shoots. The plunder down under – what to expect when spring comes. Green is Beautiful. Winter 2010. pp 8-10

Julie Dionne: Winter protection of Annual Bluegrass Golf Greens. USGA Green Section Record, Sept/Oct 2000 pp 11-13

Tompkins, D. K., P. Rochette and J. B. Ross. 2009. Mitigation of Anoxia under Ice and Impermeable Covers on Annual Bluegrass Putting Greens.

STERF (Scandinavian Turfgrass and Environment Research Foundation) is the Nordic golf federations' joint research body. STERF supplies new knowledge that is essential for modern golf course management, knowledge that is of practical benefit and ready for use, for example directly on golf courses or in dialogue with the authorities and the public and in a credible environ-mental protection work. STERF is currently regarded as one of Europe's most important centres for research on the construction and upkeep of golf courses. STERF has decided to prioritise R&D within the following thematic platforms: Integrated pest management, Multifunctional golf facilities, Sustainable water management and Winter stress management. **More information can be found at www.sterf.org**

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The CTRF is a registered charity with a mandate to raise monies and sponsor research projects that advance the environmental and economic benefits applicable to turfgrass. The CTRF is funded by contributions received from two national and six regional organizations involved in the golf and sports turf sectors. Over one million dollars has been invested in turf research in Canada by CTRF. The Foundation currently has 10 active research projects. Participating organizations include Golf Canada, the Canadian Golf Superintendents Association, the Western Canada Turfgrass Association, the Alberta Turfgrass Research Foundation, the Saskatchewan Turfgrass Association, the Ontario Turfgrass Research Foundation, the Quebec Turfgrass Research Foundation and the Atlantic Turfgrass Research Foundation. **More information can be found at www.turfresearchcanada.ca/**