

## WINTER WORK on golf greens



Photo: Tatsiana Espevig

### Summary

- At many golf courses there is limited access to manpower during the winter.
- Systems for surveillance of the turf grass' conditions should be established. Grass plant crown temperature can be recorded on-line. Manual onsite evaluations are necessary for monitoring ice formation and anoxia. A combined device for measuring snow depth and soil frost is easy to make and very useful.
- Mechanical work during the winter implies risk of physically damaging the greens, especially if the greens are undulated or not frozen. The drivers' qualifications and choosing the right equipment for the job are keys to success.
- Melting of ice and snow can be accelerated by applying chemicals or by collecting energy from sun radiation.

## Introduction

Winter play on summer greens are not common in the Nordic countries when you are a few hundred kilometres north of the Copenhagen / Malmö region. Only very close to the west coasts of Sweden and Norway will the Gulf Stream make the winters mild enough to keep the snow and frost away during most of the winter and the climate comparable to northern Scotland. This means that the winter closes most golf courses for play in the Nordics.

The climatic conditions influence the number of staff working, and at many courses you will find only one or two staff members with full year employment. Most of the staff are contracted for 6-8 months and leave for alternative winter work locally or they return to their home countries in October.

Many full time greenkeepers work a lot during the summer and extend their holidays in the winter with a month or two as compensation. This means that many golf courses are literary left to themselves without any attention from December until March and that there is very limited access to qualified personal at this time of the year if critical situations occur.

There are no statistics showing that winter work pays, and some work on the greens appear to be in vain. But monitoring the conditions and taking actions to improve the grass plants' micro-climate can be crucial during some winters. This text will give an overview of work that Nordic greenkeepers do during the winter to limit the injuries from winter stresses. Some topics are discussed in more detail in other fact sheets.



The public often have access to Nordic golf courses during winter. Picture is showing Oppedgård GC on a Sunday in March. Photo: Pål Melbye.

## Surveillance

Deep, dry snow cover gives the optimal winter conditions for golf greens. Walking on snow covered greens should be avoided, and temporary fences are necessary at many courses to keep cross country skiers or walkers off the most sensitive areas.

Monitoring the conditions in golf greens is challenging when snow covers the entire golf course, and foot-prints or snow removal can be harmful. Installing electronic devices by the grass crowns at some greens is very useful. A technical limitation on a golf course is that the greens are spread over a large area and may have rather different micro-climatic conditions. This leaves most greenkeepers to install sensors in one or two greens accessible with wires or through a local WiFi system, which has a typical outdoor range of maximum 60-80 metre. Bluetooth devices are only suitable for very short distance communication. Outdoor winter surveil-

lance needs to be waterproof and be more robust than the relatively cheap indoor devices offered by many suppliers.

Remember that cheap and simple temperature measuring devices that require manual reading is better than nothing, and a daily walk to a green edge or two is well spent time if the alternative is sleepless nights due to uncertainty about the green conditions.

### Temperature

Thermometers should be placed at the crown level in the green, between 0 and 3 mm below the surface. The precision of the instrument should be less than  $\pm 0.5$  °C, and you should calibrate the thermometer in ice slush to check 0°C.

In a plant / soil system ice formation is not occurring precisely at zero degrees for several reasons. Measurements of

respiration under covers have shown that the metabolic activity of the turf grass drops when temperature is below -2 °C, and that the oxygen level decreases when temperatures are closer to zero.

If you do not monitor the temperature continuously, a device that registers minimum and maximum temperatures is recommended. Reports on lethal temperatures for different grass species cannot be transferred directly to your greens because winter stress tolerance differs between varieties and the acclimation status varies through the winter. Collecting data about winter survival and temperatures over some year will give you very valuable data from your own golf course and knowledge that cannot be replaced by reading research reports.

## Gas concentration

Covers of ice or impermeable tarps can lead to low levels of oxygen and anoxia. (See the fact sheet “When to break the ice?”) Researchers have monitored oxygen and carbon dioxide levels under impermeable tarp and found that the sum of these two gasses is close to 15%. This means that devices that measure only carbon dioxide can be used to indicate the oxygen level ( $O_2\% = 15\% - CO_2\%$ ). Green root zone material with high organic matter will first reach the low critical level of about 7-8% oxygen. This means that the greens with high OM content should be prioritized for monitoring.

Gas meters for outdoor use produce a vacuum and inhale air from tubes that are placed under the tarps or dug down in the green. Complete ice encasement can make measurements impossible.

Reliable gas meters are expensive (€ 2000-3000) and probably not the first choice on a limited budget unless you work with winter protective covers.

Under anoxic conditions the plant and microbe respiration will produce chemicals with an intense smell. Your nose is a very useful tool to explore the conditions under ice. If gases like methane are produced you sometimes also can find “micro-volcanoes” growing through the ice. See pictures.

## Frost in the ground

There is a cheap and reliable way to monitor soil frost development in greens. It is based on the fact that the chemical methylene blue loses its colour and becomes transparent when it freezes.

A “frost meter” can be made from simple parts, and the very small amount of chemical needed (two “match heads” of crystals per litre) can be found at the chemistry lab at the local school or purchased at a good pharmacy. See figure 1.

The frost meter can be installed in the green inside a tiny (Ø15mm) plastic tube (used by electricians) that also can serve as a snow depth meter. Avoid walking to the device, as snow compaction will influence the soil frost. Set up a wooden ramp.

Information about the depth of ground frost can help you to evaluate if water will drain through the root zone, and to estimate when soil temperature can be expected to increase in spring.



Above: A trained nose can be used to track anaerobic metabolites and evaluate the status for the turf. Photo: A. Kvalbein. Below: Gas escapes through the ice and dirty water spread on the surface when there are anaerobic conditions and the soil microorganisms are active. Photo: Ole Albert Kjøsnæs.

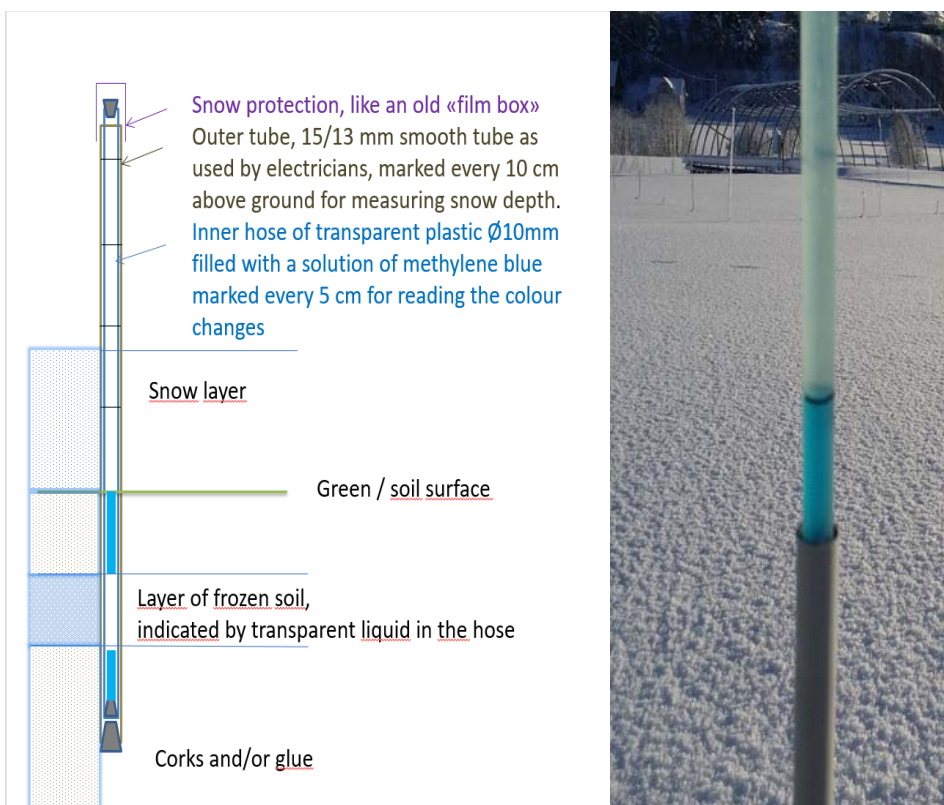


Figure 1. A combined frost and snow depth measuring tool can be made and installed similar to this illustration. Photo: T.O.Pettersen.

## Soil moisture

It is difficult to monitor the soil moisture during the winter because liquid water and ice give different signals to the devices. In soil science experiments the neutron scattering method can be used. We conclude that there are no practical ways to measure soil moisture during the winter.

## Sampling grass

The grass plants' conditions can be tested by bringing in cylinder samples and growing them in pots.

Samples from frozen greens can be taken with a concrete hole saw (25-45 mm) and a chisel and grown in your office window or under a fluorescent tube.

You should be aware that samples from a mixed stand of turf grasses may not be representative, and that there can be differences from high to low parts of an undulated green.

## Ice formation

Ice can form under snow during rain or from melting snow. The only way to monitor this is to dig down to the green surface and check the thickness and quality of the ice visually. Read more about ice quality in the fact sheet "When to break the ice".



Sampling plant material from greens is not easy. Here we found slush between the snow and the frozen root zone. Photo: A. Kvalbein



Under a snow cover 7 cm of solid ice had formed on top of this green. Ice with a high content of air pores is white. Solid ice is transparent. Photo: A. Kvalbein

# Driving on golf greens

There is always a risk of making mechanical injuries on the surface, especially when using a tractor-mounted loader on undulated greens. The thickness of ice covers are also variable and cracking ice with an aerator is always risky. Excellent driving skills, first class local knowledge and good tools reduce the mechanical injuries.

## Snow handling

On locations where huge amounts of snow are rare, it can be difficult to find suitable equipment for snow removal. The kind of tools that should be used is depending on the ground's carrying capacity and how exposed the plant crowns are. When the greens are frozen they can carry heavy machinery, but a very popular piece of equipment is the front set rotary snow plough. See picture. Not all tractors



A tipper truck is not the most common machine on greens, but it can be used if the ground is deeply frozen. Photo: Magnus Barth

have the front transmission necessary to run this machine.

When the greens (or the green surrounding area) are not frozen, only lightweight tractors should be used. Snow blowers are suitable for golf greens and are able to throw dry snow out of a 600m<sup>2</sup> green without re-handling.

A softer tool for removing small quantities of snow or cracked ice is a rotating brush used on the front mounted loader.

The rationale for handling snow is discussed in other fact sheets, but they can be divided into three groups; 1) to control soil /plant temperature, 2) to remove snow that can melt and turn into ice, 3) to speed up the spring growth.

## Ice cracking

Cracking ice is a tough job for most machines, but the most used equipment is tractor mounted aerators with thick, solid tines. If the ice is more porous the cracking can be done with heavy spike rollers.

## Melting

Another and more careful way to remove ice and snow is to accelerate snow melt. It can be done by applying chemicals or collecting sun radiation energy.

Salts can lower the melting temperature and turn ice into water. The temperature will decrease and the use of salt is not a good idea if the cold water does not run off the greens. The most effective salt is MgCl<sub>2</sub>, but also CaCl<sub>2</sub> can be used. A more expensive, but less risky product is CMA (Calcium-Magnesium-Acetate). The granules will penetrate the ice without producing much water, but it is not efficient when the temperature is some degrees below zero. We have used up to 100 g CMA per m<sup>2</sup> turf in a pot experiment without seeing any negative effects.

Sun radiation can give more than 500W per m<sup>2</sup> in April and if the reflection from the snow (albedo) is eliminated, snow and ice will melt rapidly. The use of dressing sand is the first option. It can be coloured black by using charcoal powder to increase the effect. Charcoal powder can also be used alone. Some use fine granulated organic fertilizer, but the environmental effect of nutrient runoff might be questioned. We do not recommend lime either because pH regulation should be done more precisely on greens.

Early melting of the snow may expose the turf to low temperatures and other spring stresses. See the fact sheet "Spring stresses".



Front mounted rotary snowblower, here combined with a vibrating aerator that is suitable for ice cracking. Photo: A.Kvalbein.



An old aerator used for ice cracking on a golf course in Trondheim, Norway where ice causes big challenges almost every winter. Photo: Ole Albert Kjøsnes.



Melting water can cause problems during the winter. A portable pump can be useful for reducing ice encasement. Photo: Allan Ferm, Grønmo GC, Oslo. 28 January 2016.

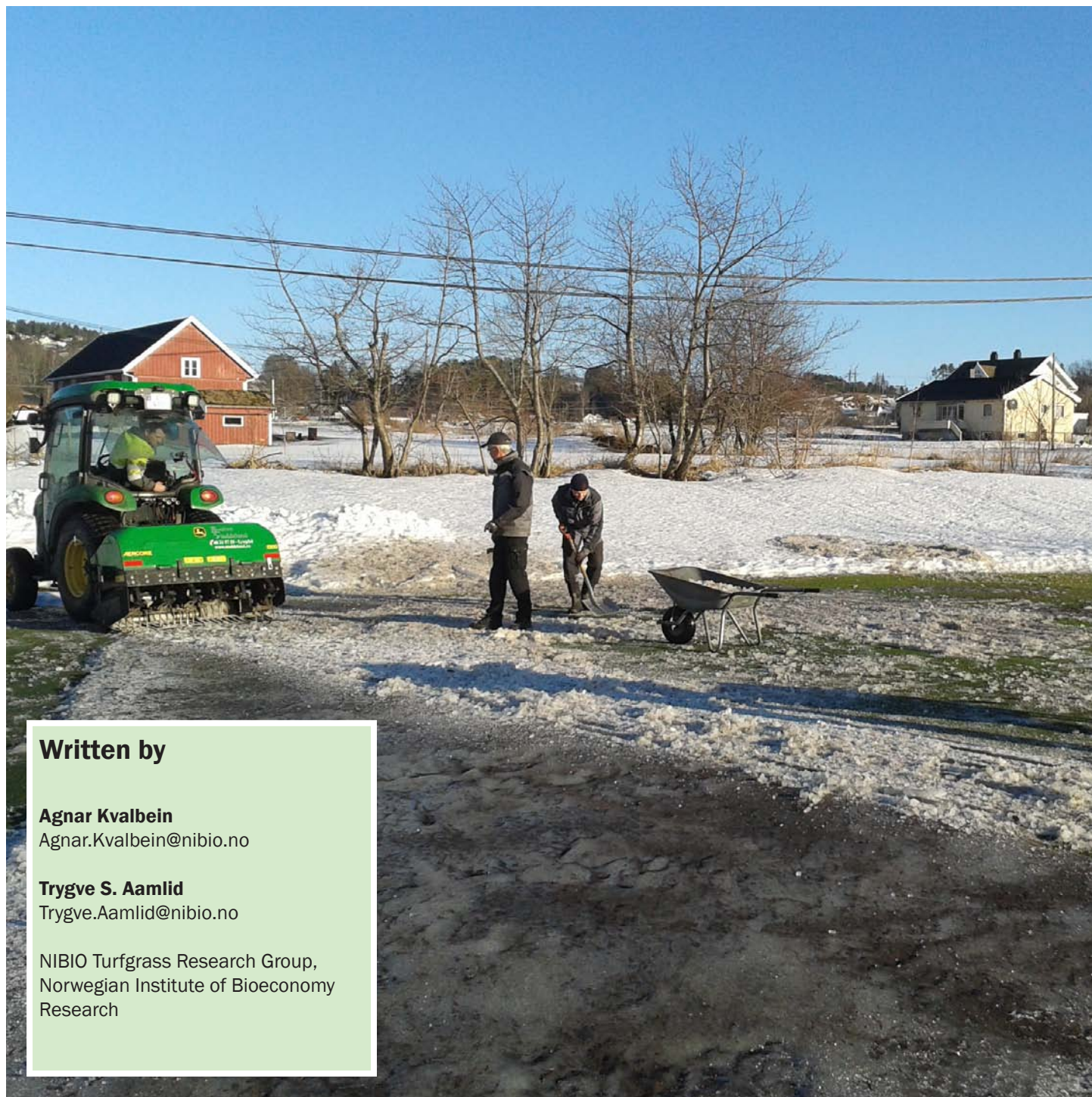


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# STERF

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 environmental 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](http://www.sterf.org)**

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