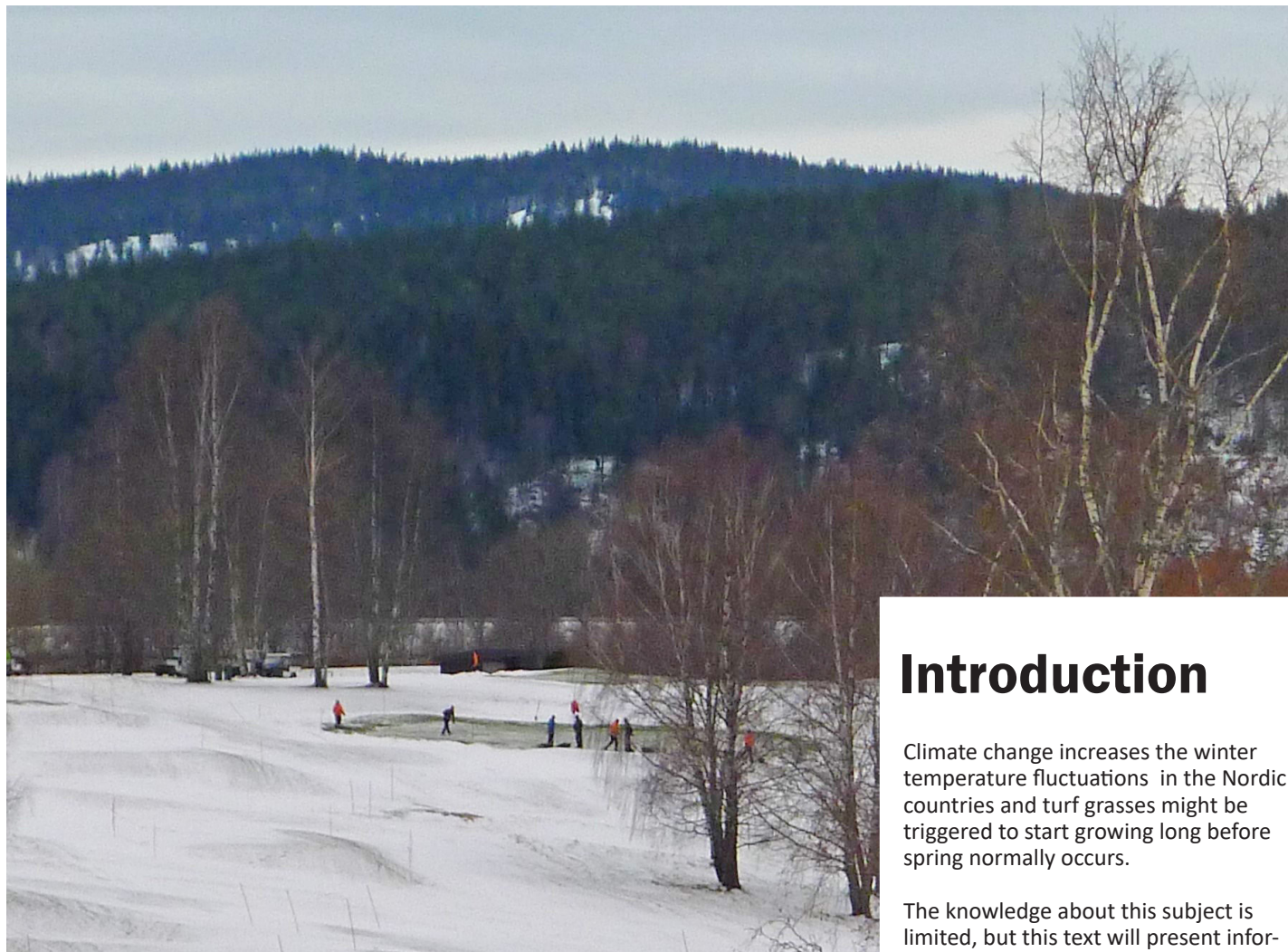


WARM SPELLS DURING THE WINTER

De-acclimation and risk of winter injuries on turf



Introduction

Climate change increases the winter temperature fluctuations in the Nordic countries and turf grasses might be triggered to start growing long before spring normally occurs.

The knowledge about this subject is limited, but this text will present information based on scientific reports and experiences from our research facilities.

Some football stadiums have access to soil heating systems and artificial light. The use of these tools can cause situations similar to mild spells. The same effects we see from usage of protective covers that capture solar energy and increase the turf temperature.

The relation between ice encasement and temperature is discussed in the fact sheet *“When to break the ice”*.

This text focuses on golf greens, but the information can be useful for other turf areas too.

Summary

- Well acclimated plants can tolerate winter stresses although there are major differences among grass species.
- Warm spells during the winter will trigger the grass plant to de-acclimate, and hence become more susceptible to winter injuries.
- It is difficult to be precise about how many days the grass species need at a certain temperature to become de-acclimated, because there are too many factors in play. However, in practicality, annual meadow grass is more vulnerable to de-acclimation than bent grasses and fescues.
- The closer we get to the spring, the more vulnerable plants will be to injuries from rapid temperature drops or other stresses.

De-acclimation

The process of acclimation is explained in the fact sheet “Winter stresses and plant acclimation”.

De-acclimation is a process opposite of acclimation and it means that the plants lose their freezing tolerance and ability to survive other winter stresses. The main factor that triggers de-acclimation is temperature. The grass species are not equally susceptible to de-acclimation during warm spells, and this makes it difficult to find the critical temperatures and durations for de-acclimation to occur. When plants have been acclimated to a certain degree, all temperatures

which are warmer than those the plants have already experienced can trigger de-acclimation. Hoffman et al. (2014b) found that annual meadow grass (*Poa annua*) exhibited a greater loss in freezing tolerance at lower temperatures (4 °C vs. 8 °C, e.g.) and shorter durations (1 day vs. 5 days, e.g.) than creeping bent grass (*Agrostis stolonifera*). Hoffman et al. (2014a) also found that annual meadow grass was completely de-acclimated after five days at 8 °C.

De-acclimation is a faster process than acclimation and it can be completely reversible, partly reversible or completely ir-

reversible depending on the temperature and duration of de-acclimation period.

Warm spells followed by a rapid temperature drop in winter after plants are de-acclimated are very critical and can be claimed to be a major reason for winter kill of the turf grasses. The grass crowns are normally under the soil surface, and it is not likely that the turf will be de-acclimated and start growing if the soil is frozen in the upper 5 cm of the green.

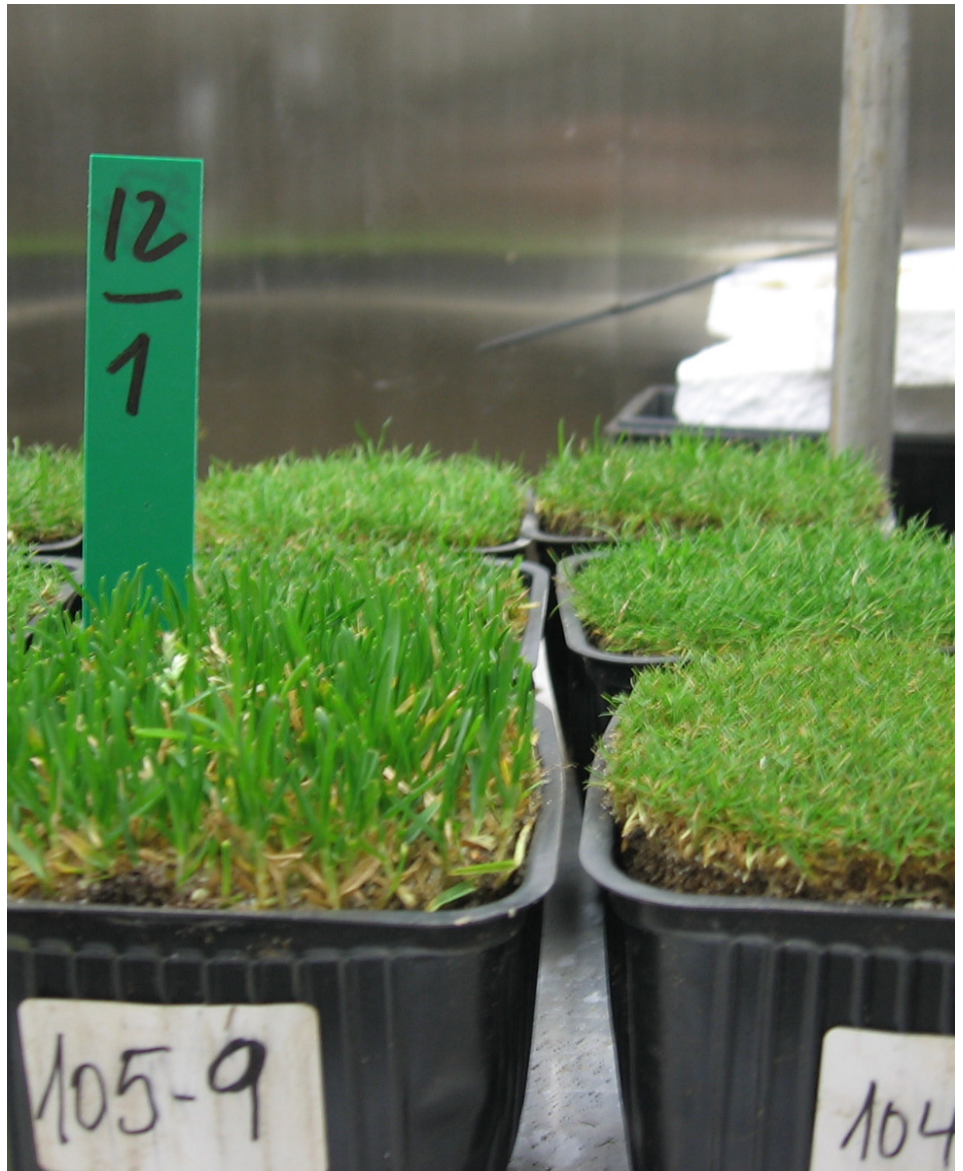
Does winter dormancy make growth impossible?

The term dormancy is sometimes used to describe the physiological status of a plant that is not growing. We prefer use the term acclimated (or hardened) plants. (Read more about acclimation in the fact sheet “Acclimation and winter stresses”.) Well-acclimated plants have water permeable cell membranes. Water pressure is necessary for growth because it is the hydraulic water pressure that expands and elongates a growing cell.

De-acclimation of the plants caused by increasing temperatures is therefore necessary in the spring to make the grass grow again. But such growing plants are much more vulnerable to winter stresses than acclimated plants. Thus, low freezing temperatures or a period of snow cover (risk of snow mould) is likely to cause greater damage in the spring than in the late autumn.

Differences between species

Only a few studies have been conducted comparing de-acclimation of different turf grass species, and comparing them is difficult because their initial ability to resist winter injuries after acclimation in the autumn varies a lot. The most comprehensive study so far (Espevig et al. 2014) concluded that creeping bent grass usually develops superior winter tolerance after acclimation in the autumn, and this buffers against a relatively quick de-acclimation found during warm spells. Annual meadow grass is also easily de-acclimated, and this is far more critical because annual meadow grass never reaches the



Annual meadow grass (to the left) and velvet bentgrass (to the right) together with 4 other turf grass species (pots behind) were first acclimated in the field to the end of November 2011. After de-acclimation treatment at 10 °C for 12 days, annual meadow grass initiated growth while no growth was recorded in velvet bentgrass.



Removing the first snow when it is necessary to improve soil frost is common practice at Oslo golf course. Note that the cross-country skiers find that golf courses provide perfect conditions when the snow cover is very thin. Photo: Agnar Kvalbein

same level of acclimation as creeping bent grass. This study also showed that the reason why annual meadow grass is not winter hardy at all is not only its rapid de-acclimation but also inability to stop growth in response to low temperature and thus inability to acclimate.

The slowest grass species to get out of the acclimated state is slender creeping red fescue (*Festuca rubra* ssp. *litoralis* (=ssp. *trichophylla*)). Velvet bent (*A. canina*) will also lose its acclimation status slowly, and for this reason it is for practical purposes considered to be just as winter stress tolerant as creeping bent grass.

Colonial or brown top bent grass (*A. capillaris*) and Chewing's red fescue (*F. rubra* ssp. *commutata*) develop a moderate freezing tolerance in the autumn, but like slender creeping red fescue the Chewing's fescue partly compensate by being resistant to de-acclimation.

After de-acclimation, these turfgrass species are not able to retain their initial acclimation status by re-acclimation.

Harmful effects of covers

Protective winter covers are produced in different colours. Dark coloured covers

will absorb more energy from sun radiation and increase the turf temperature. Because single covers without any insulating material do not protect the grass from either low or high temperatures, these coloured covers will increase the risk of winter damages if warm spells occur.

Under artificial covers there are also excellent conditions for snow mould fungi, and covers should not be used without applying fungicides in the autumn. (Read more about covers in the fact sheet "Winter protective covers").

Ice covers or ice encasement can be very harmful to turf. (See the fact sheet "When to break the ice" for more details). Field trials and experiments under controlled conditions have shown that the oxygen concentration decreases to anoxic levels when the temperature is above -2°C probably because the plant cells and the soil micro-organisms thaw at this temperature and start respiring. (Castonguay et al. 2009)

In practise it is very difficult to prevent temperature increase, but lasting temperature above -2°C under an ice cover should alert the golf course superintendents to check the conditions and prepare for ice cracking.

Recommendations

Keeping the turf temperatures optimal for winter survival (probably at the interval of -3 to -6°C) is impossible. The best conditions that nature can offer are initial freezing temperatures in the late autumn, which create frost in the soil, followed by a stable snow cover that lasts until spring. Under lasting and deep snow soil surface temperature will increase over time until about zero. Snow moulds like to grow under these conditions, and access to effective fungicides is a precondition for success.

A few Nordic golf course superintendents like to keep their greens free from snow through the winter. This practice will normally create deep frost in the greens and the turf grass crown will be kept cool under warm spells from the ice stored in the root zone. The risky parts of this practice are the exposure to extremely low freezing temperatures and that ice covers will form quickly if precipitation comes as rain during the winter. Success with this strategy can only be achieved if you grow grasses like creeping or velvet bent grasses that can tolerate low temperatures and ice encasement. You should also be in an area where risk of temperatures below -25°C and risk of desiccation from sun and wind is low.

Establishing frost in the greens in the autumn before permanent snow can be very beneficial. Removing snow from unfrozen green recommended if you have staff and equipment that can do the job without harming the playing surface.

Blowing snow on to the greens during the winter to prevent temperature increase and de-acclimation is an option if snow is available.

Preserving the green frost by using white tarps during sunny days and removing them before cold nights is labour intensive but possible. When the warm spell is caused by mild, rainy days there is not much you can do about it. Unfortunately the expected climatic changes will give us bigger fluctuations in temperatures and the winter conditions will be harder to predict.

At some date in the late winter you will decide that warm spells are welcome and prepare for spring growth. Spring can also be very stressful to the grass plants. Read more about this in the fact sheet "Spring injuries".

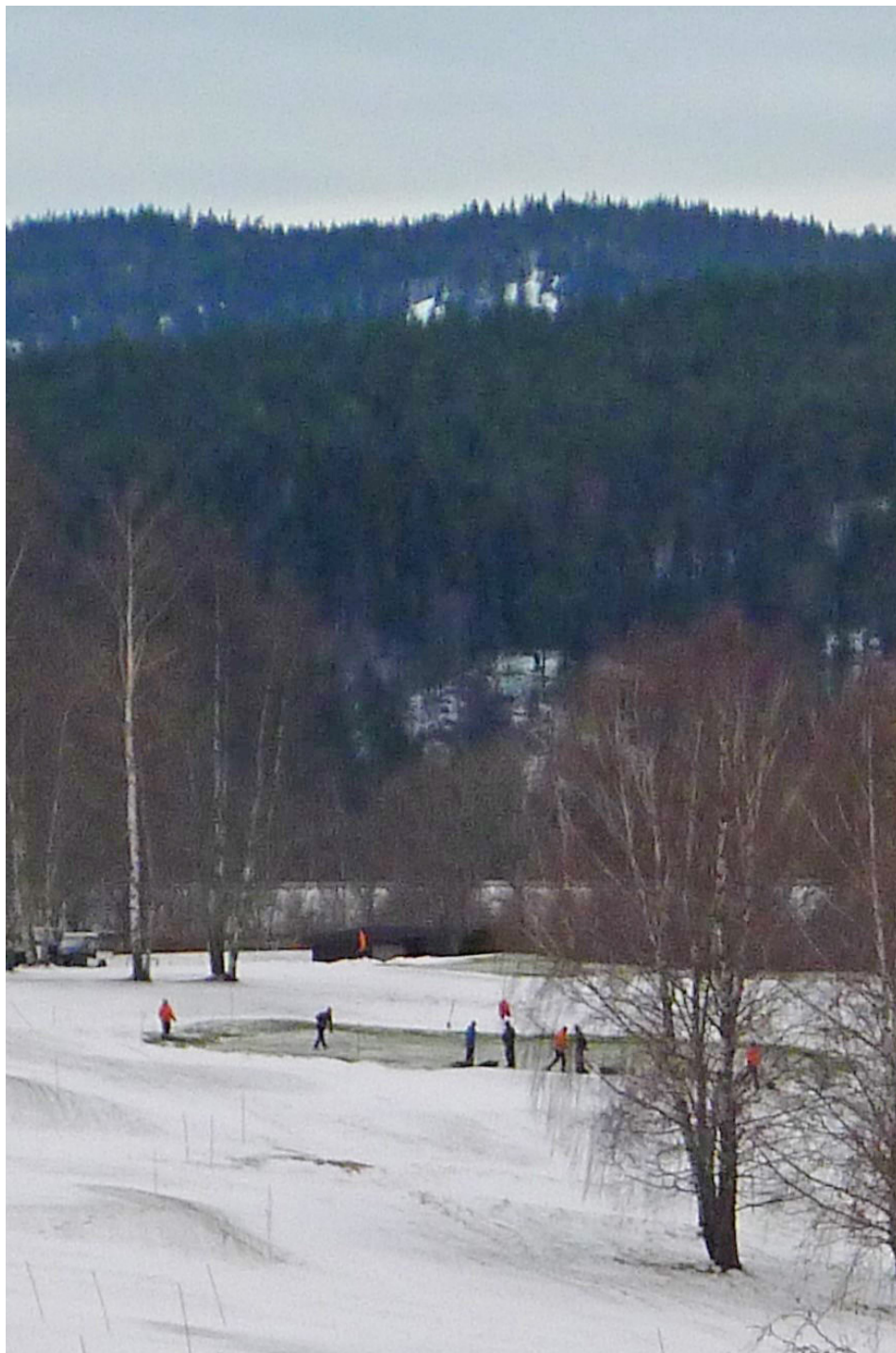


Photo: Agnar Kvalbein.

Written by

Agnar Kvalbein
Agnar.Kvalbein@nibio.no

Tatsiana Espevig
tanja.espevig@nibio.no

Trygve S. Aamlid
Trygve.Aamlid@nibio.no

NIBIO Turfgrass Research Group,
Norwegian Institute of Bioeconomy
Research

Read more

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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**

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