SPRING STRESSES
The difficult transition into a new growing season

Photo: T. Espevig

Introduction

Many golfers and even more golf course superintendents experience disappointments in the spring. The greens look nice when snow melts, but they lose their green colour, grow very slowly and do not resist wear. How can we explain this other than blaming the low temperatures? Research projects on spring injuries on turf grass are very few. There are comprehensive studies on how winter cereals tackle the transformations between growing phase / acclimation and de-acclimation. Unfortunately this research has revealed that there are differences between species that make it difficult to draw conclusions directly from cereals to turf grasses.

Still there are many questions to be answered related to spring injuries on turf grasses.

Summary

- Grass plants can be very weak after the winter and the increase of sun energy in the spring gives the turf new challenges related to desiccation and sun burn. The use of spring protective covers can be beneficial, but can also result in more vulnerable once the cover is removed.
- Roots can be teared off or injured during the winter and this could be a problem. Frequent irrigation and fertilization is recommended.
- Fertilization in the autumn and in the spring can improve plant recovery. Excessive use of nitrogen should be avoided in early spring if the turf is energy -depleted after winter stresses. High rates of phosphorus is negative for the environment and do not improve spring growth.

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Sterf

Protective covers (tarps) in the spring improve growth and visual impression of the turf, but not always resistance to wear. Photo: A. Kvalbein

Spring stresses

The grass plants will often suffer from energy depletion after a long period with little or no photosynthesis. Groups of plant cells can also be killed by ice formation or intruded by fungi. It is difficult to evaluate whether a single plant is dead or alive when spring comes. Only a few live cells in the plant crown (meristem) can be enough to produce new leaves in the laboratory or under optimal condition. On a green there are of course less optimal conditions.

Here we will discuss the most typical stresses encountered by turfgrasses in spring. Even though the turf has survived the winter, there are challenges related to the fact that plants have been deacclimated and to the high energy fluxes going into and out of the canopy at this time of the year. Issues related to the reestablishment of wholly or partly dead turf have been discussed in the fact sheet *"Reseeding and spring recovery from winter injuries".*

High light intensity

All greenkeepers know that plants are dependent on light, but it is less known that they can also be seriously harmed by light. We call this photoinhibition, and it is related to low temperature and intense sunlight.

Plants have developed a huge arsenal of different protection mechanisms to resist damages from light. Some of them are the anti-oxidants that have received publicity in the past few years because they might also protect human cells from damages. In the fact sheet "Acclimation and winter stresses" we explained what makes plant cells resistant to ice formation. Parallel to this acclimation the photosynthetic apparatus undergoes biochemical and structural changes to be able to resist sun burn. When day temperatures decrease in the autumn the biochemical part of the photosynthesis (The Calvin cycle) slows down while the photochemical production of energy carriers goes on independent of the temperature. The result is a potential harmful accumulation of electric energy on the cell membranes. Luckily, within minutes or hours, healthy plant cells can adapt to new light conditions, but very rapid changes can be harmful, indeed in combination with energy depleted plants in the early spring.

This explains what we sometimes observe on the greens. The grass leaves that were produced in the autumn under very low light intensity in October are injured when they come out of the snow and face the intense light in the beginning of April.

The use of spring covers to increase temperature and speed up the growth can be very tempting and sometimes advantageous. But the leaves formed under covers in a humid and shaded environment are adapted to low light intensity and are usually very vulnerable to wear. If the covers are removed on a sunny day the rapid change of light conditions can harm the plants. Instant play when covers are removed can also be costly.

We call it *photo bleaching* when the leaves turn pale and may wilt due to photoinhibition. The injury is often hard to distinguish from desiccation.

Desiccation

Desiccation of the turf can happen all through the winter when wind and low freezing temperatures hit exposed turf and cause "freeze-drying", which can be lethal. However, since the sun angle is low and the radiation negligible during winter in the Nordic countries, the turf is more likely to dry out in the spring. In April the radiation to horizontal ground can reach 600 W/m^2 in the middle of a clear day in the capitals of Oslo, Stockholm and Helsinki. Grass is well adapted to dry conditions and drought alone will rarely kill the grass completely, but dried grass plants will not grow. They do not have the water needed to produce turgor pressure which is again necessary to elongate new cells.

Uptake of water depends on functional roots, but grass roots seldom live for more than one year and may be killed during the winter. Frost heave can tear off the roots during the winter, and this may explain why grasses do not store carbohydrate reserves in the roots like many other perennial plants, but concentrate energy in the meristems. Often, new roots must be developed from the crowns before water uptake can occur. Moist soil surfaces will stimulate and help developing these new roots, and spring dressing and rolling will improve the contact between grass crowns and soil. Under very dry conditions a spring cover can be beneficial because it reduces the evapotranspiration and preserves soil moisture.

Irrigation

We find that spring irrigation often is neglected. The transpiration from grass leaves on sunny and windy days in March can be considerable.

Some courses do not have access to water in the spring because of technical reasons. We also find some golf course superintendents are afraid of cooling down the turf with very cold water. It is true that water evaporating from the turf surface will lower the temperature, but it is found that the irrigation droplet temperature always equals the air temperature (measured with a moist thermometer) (B.Hannesson, 2009). This means that the temperature in the water source doesn't matter. Irrigating in the afternoon when the air temperature is at maximum should be considered.

If you want the grass to start growing, irrigation is very important. Sometime, if you think it is too early for growth, you can hold back the plants by drought. This could be beneficial in situations where you expect low freezing temperatures or more snow.

When the turf has started growing, you should apply sufficient water and let the temperature limit spring growth. Many greenkeepers have good experiences with an early application of a soil surfactant.

Fertilization

We have a simple, but well tested and documented fertilization philosophy for golf greens: The plants should be spoon-fed with one well-defined mixture of nutrients where nitrogen is the minimum factor (see fact box) all through the year, and the weekly rates should be adapted to the growing conditions (first of all temperature and light).

In the spring we normally would like to exploit the grass species' maximum growth capacity if the turf is thin or injured, while in the summer season will we limit the growth to what is needed to resist wear. You can read more about this in the STERF handbook: *Precision fertilization.*

How hard you can push spring growth with fertilization (where nitrogen is the steering factor) is depends on the grass species' growing capacity, but also the carbohydrate status of the plant should be taken into consideration. A depleted plant should not receive high nitrogen rates because it initiates growth and most of the sugar production will be used for shoot growth and less to root development and general restitution of the plant. The first fertilization should be modest but the rates can soon be increased when the temperature picks up and the growing conditions are good.

Relative need for plant nutrients (elemental) on weight bases when nitrogen = 100		
Nitrogen	N	100
Potassium	K	65
Phosphorus	P	14
Sulphur	S	9
Calcium	Ca	7
Magnesium	Mg	6
Iron	Fe	0.7
Manganese	Mn	0.4
Boron	B	0.2
Zink	Zn	0.06
Copper	Cu	0.03
Chlorine	Cl	0.03
Molybdenum	Mo	0.003
Nickel	Ni	N/A

Autumn fertilization has positive impact on the spring growth, but excessive fertilization with nitrogen increases the risk of winter injuries. The turf becomes more susceptible to microdochium patches and pink snow mould (*Microdochium nivale*). Increasing nitrogen rates also reduce the freezing tolerance of creeping bent grass. Our recommendation for autumn applications is to keep the turf grass green, but not stimulate leaf growth in the autumn. More detailed recommendations will be published in November 2017.

If the roots are injured by the winter the nutrient uptake can be restricted and usage of foliar fertilizer can be beneficial to supply a limited amount of nutrients for leaf uptake.

Low temperature has great negative impact on the efficiency of slow release products. They should be avoided until the soil temperature is adequate.

Some grass varieties turn purple in early spring. The anthocyanin pigment is produced as a protection to avoid photoinhibition. The colour can be misinterpreted as a symptom of phosphorus deficiency and this can perhaps explain why spring fertilizer products often have relatively high contents of phosphorus (P). We find no reports supporting that established turf benefit from excessive rates of P. On the contrary, extraordinary high P rates in the spring should be avoided. When temperature is low P fertilizer will remain longer in a water soluble stage and the risk of leakage through the drain system is high and this is a waste of a limited resource.

One single application of fertilizer (20 N kg/ha) in November improved spring growth on this fescue/bent/Poa green in May. The green received two spring applications when this picture was taken. Photo: A.Kvalbein

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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/**