

GRASS SPECIES AND VARIETIES for severe winter climates

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Ice-covered SCANGREEN-trial at Apelsvoll February 2020. Photo: Pia Heltoft.

Introduction

This fact sheet will help you choose the most winter hardy grass species and varieties when establishing, re-seeding, or over-seeding golf courses or other turfgrass areas in the Nordic countries. We focus on grass for golf greens, but fairways, tees, sports fields, and recreational lawns will be covered too.

Many golf courses aim to renew their turf to improve winter tolerance. Successfully changing the sward composition on a green is a complicated process that also includes new maintenance strategies. Re-establishing dead areas after winter injuries or gradually changing the genetic composition of a green is not covered in this fact sheet. Info can be found in the fact sheet: 'Re-seeding and spring recovery from winter injuries'.

Summary

The most winter hardy turfgrass species for golf courses and other recreational areas are Kentucky bluegrass (*Poa pratensis*), prostrate (*supina*) bluegrass (*Poa supina*), velvet bentgrass (*Agrostis canina*) and Chewings fescue (*Festuca rubra* ssp. *commutata*).

If fungicides are used, creeping bentgrass (*Agrostis stolonifera*) and some varieties of colonial (browntop) bentgrass (*Agrostis capillaris*) are also very winter hardy.

The species most susceptible to winter damage are rough bluegrass (*Poa trivialis*), perennial ryegrass (*Lolium perenne*) and annual bluegrass (*Poa annua*).

There is significant variation among varieties within most species and especially in colonial bentgrass and strong creeping red fescue where a couple of Norwegian varieties have far better winter stress tolerance than varieties from lower latitudes.

Recommendations in this fact sheet are based on more than 20 years results from variety testing in SCANGREEN and SCANTURF (www.scanturf.org and www.sterf.org).

Species, varieties and ecotypes

When a new variety is put on the market it is defined as a certain species. Most of the turfgrass species for golf greens are bred from ecotypes that are collected from various parts of the world. When a new variety is labelled and sold, it has been proven to be distinct from other varieties and the genetic composition stable and consistent over years. There are some varieties that are based on genes from a limited geographical area. These varieties are more sensitive to day length and their adaptation to winter stresses is more robust as they are less dependent on low temperatures during the autumn to be acclimated.

Annual bluegrass invades many greens as a weed but can create magnificent putting surfaces. Only a few varieties are sold on the market. When this species is evaluated by researchers, it is especially important to know the origin of the particular ecotype or variety. Since annual bluegrass produces seed even at low mowing height, it is genetically flexible and will, over the years, adapt to the local climate and maintenance regime.



Winter damaged SCANGREEN at Apelsvoll May 2021. Good survival in colonial bentgrass 'Leirin' in front plot to the right. Photo: Pia Heltoft

Winter stress tolerance

There are several reasons why grass plants are injured or killed during the winter. This is covered in other fact sheets, but the different stresses can make it difficult to rank turfgrass species and varieties according to the general term 'winter stress tolerance'. Some species do, for instance, tolerate low freezing temperatures, but are severely attacked by snow molds. In most species there is a positive correlation between the ability to resist abiotic damages such as freezing, desiccation and ice encasement and the ability to resist winter-active fungi.

For all these stresses, the tolerance is closely related to the acclimation (hardening) status of the plant. When a grass plant is well acclimated and prepared for the

winter, it has stopped growing and accumulated extra sugars. Anti-freeze proteins have been produced inside the cells, and the cell membranes have been changed for improved stability under freezing and thawing conditions.

The acclimation status of the plant depends on environmental factors with temperature as the most important signal. A period of low temperatures in autumn induces winter acclimation, but warm spells during the winter can de-acclimate the plants again. The turfgrass species vary in how sensitive they are to these warm periods.

The following ranking of turfgrass species is first and foremost based on the evalua-

tion of species and varieties at Nordic locations over the last 20 years. The test programs SCANGREEN and SCANTURF include both coastal and inland climates at latitudes between 56 and 65 °N. Results on species are summarized in The Nordic Turfgrass Guide and lists of recommended varieties are updated regularly at www.sterf.org and www.scanturf.org.

Several STERF research projects have added specific knowledge about the species' freezing tolerance and ability to survive under different maintenance and climatic conditions. Results are summarized in the text below. More detailed reports can be found at www.sterf.org

Ranking species for golf greens

In the following table the grass species used on golf greens have been ranked on a scale from 1-9 depending on their ability to survive a Nordic winter.

Please note that our test plots are not sprayed with fungicides. This means that the genetic resistance to microdochium patch (*Microdochium nivale*), gray snow mold (*Typhula incarnata*) and more rare winter diseases are a part of the ranking.

Species	Score for winter stress tolerance								
	9	8	7	6	5	4	3	2	1
1. Velvet bentgrass (<i>Agrostis canina</i>)			7	6					
2. Chewings fescue (<i>Festuca rubra</i> ssp <i>commutata</i>)			7	6	5				
3. Prostrate bluegrass (<i>Poa supina</i>)			7						
4. Creeping bentgrass (<i>Agrostis stolonifera</i>)			6	7	6	5			
5. Colonial bentgrass (<i>Agrostis capillaris</i>)		8	7	6	5	4			
6. Slender creeping red fescue (<i>F. rubra</i> ssp. <i>litoralis</i>)				7	6				
7. Rough bluegrass (<i>Poa trivialis</i>)						4	3		
8. Perennial ryegrass (<i>Lolium perenne</i>)						3	7	6	
9. Annual bluegrass (<i>Poa annua</i>)						3	4	7	6

Winter hardiness of grass species under golf green conditions in the Nordic climate, ranked from 1 to 9, where 9 is best.

The width of the coloured band shows the variation between varieties (or ecotypes for the annual meadow grass). The dark red area indicate the score of the most popular varieties.

1. Velvet bentgrass

Several research projects have confirmed that velvet bentgrass is one of the most winter stress tolerant grass species for golf greens. It may be rather susceptible to microdochium patch and other diseases during the growing season, but it usually resists snow molds, especially gray snow mold, better than creeping bentgrass when acclimated. There are only a few varieties on the market. 'Nordlys' (unfortunately not available as of 2024) has very high tolerance to anoxia, while 'Avalon' should be avoided in extreme winter climates.

2. Chewings fescue

This subspecies of red fescue is ranked better than creeping bentgrass for overall winter survival. This is mainly because it is less affected by snow molds. Its freezing tolerance is, however, less than creeping bentgrass, but the tolerance to ice encasement is higher in Chewings fescue compared to creeping bentgrass. On

greens with good surface runoff Chewings fescue can be recommended as very winter stress tolerant, but be aware that at Apelsvoll, Norway (61°N, 250 m a.s.l.) some varieties do not achieve high scores for winter hardiness.

3. Prostrate (supina) bluegrass

This species has been tested only for a few years, but it has been ranked among the most winter hardy species, especially in Iceland and in continental parts of Central and Northern Scandinavia. It grows aggressively and the light green, almost yellowish plants tend to spread to areas where they are not supposed to be. Although winter-hardy, its leaf texture is almost too coarse for greens. We do not recommend this species except in special cases, e.g. on enclosed soccer fields and on isolated and shaded tees.

4. Creeping bentgrass

This species generally has good winter survival, but most varieties are susceptible to snow molds. This means that access to fungicides is a prerequisite

for successful winter survival of creeping bentgrass. The old variety 'Pennecross' was top ranked at the test sites with the toughest winter climates for many years, but new varieties like '777 Triple Seven', 'L-93 XD', 'Matchplay' and 'Luminary' now top the list. Varieties like 'Pure Distinction', 'Declaration' and 'Pure Select' have shown poor winter survival at the northern test sites. Creeping bentgrass has very good freezing tolerance and can resist suffocation under prolonged ice encasement, but not for as long as velvet bentgrass.

5. Colonial bentgrass

The Norwegian variety 'Leirin' has outstanding winter hardiness when tested at the Northern locations in SCANGREEN. Although its leaf fineness is not on level with the best varieties, it can be recommended for golf courses that use a mix of bentgrass and fescue in a tough climate. The Danish variety 'Jorvik' and the North American varieties 'Heritage' and, in particular, 'Puritan' are also in line with the most winter tolerant varieties



Winter survival of creeping and velvet bentgrass at Apelsvoll, Norway, May 2005. Photo: Bjørn Molteberg.

of creeping bentgrass. Otherwise, most varieties of colonial bentgrass have less tolerance to freezing and microdochium patch than creeping bentgrass. 'Charles', which for many years has been the top-ranked variety on the UK STRI/Bingley list, is very susceptible to both microdochium patch and abiotic winter stresses and should therefore be avoided in the Nordic countries.

6. Slender creeping red fescue

This subspecies has several good characteristics (e.g. good off-season color and

good competition against weeds) that makes it valuable on red fescue greens, but in our trials, it has usually been less winter hardy than Chewings fescue. 'Cezanne', 'Baroyal' and 'Nigella' are among the most winter-hardy varieties on the Nordic market. The old variety, 'Barcrown', should be avoided on greens at locations with tough winter conditions. On a side note, US research often shows slender creeping red fescue to have equivalent or better winter stress tolerance than Chewings fescue, meaning that there is room for genetic improvements in both subspecies.

7. Rough bluegrass

Some Scandinavian greenkeepers use this species to re-establish dead annual bluegrass-greens in spring. It germinates fast, but persistency on greens has been poor under Nordic conditions. The varieties on the market were mostly developed for overseeding and winter play on Bermuda greens in the southern United States and Mediterranean areas, and differences in winter performance are therefore marginal.

8. Perennial ryegrass

This is not one of the main grass species on Nordic golf greens, but it is used as a 'first aid species' to re-establish greens after winter kill. The genetic variations in winter survival among the many varieties of ryegrasses are relatively small. Tetraploid ryegrasses are more resistant than diploid ryegrasses to snow molds. They can be used to overseed fairways, tees and roughs, but they will hardly produce acceptable densities at green's mowing height.

9. Annual bluegrass

Very few commercial varieties have been tested in the Nordic countries and the winter stress tolerance has always been very poor, both when it comes to ice encasement and microdochium patch. Those who want annual bluegrass on their greens should rather preserve and develop their own local ecotypes. Coastal and southern golf courses in the Nordic countries often have acceptable survival of annual bluegrass, but they usually depend on fungicides to produce acceptable putting quality.



Microdochium patch in varieties of creeping bentgrass and red fescue. Landvik, April 2022. Photo: Tatsiana Espevig.

Ranking of species and varieties for tolerance to ice encasement on greens, including hypoxic/anoxic conditions

Definitions

Anoxia means that there is no oxygen left in the atmosphere. Hypoxia means that there is a decrease in oxygen supply, but still some oxygen available. While these terms refer to oxygen supply, ice encasement or use of impermeable covers may also result in the accumulation of CO₂ or other metabolites that are toxic to the plants at high concentrations.

Genetics and acclimation conditions

Some grass species can survive under long lasting ice cover while others die after a few weeks. This characteristic is related to the species' ability to slow down their metabolism (some call it "go dormant"), and to tolerate the altered gas composition under ice or plastic.

Species for greens

Laboratory and field experiments on golf greens have compared species' ability to survive under ice encasement or in sealed plastic bags at 0,5 °C after acclimation. Results were somewhat contrasting, and reasons for that may be that conditions varied depending on acclimation, air pores in the root zone, ice quality and other factors. It is fair to assume that the lack of oxygen was more severe in the lab than in the field experiment.

Both experiments agreed in ranking velvet bentgrass as superior in tolerance to ice encasement.

In the field experiment at Apelsvoll, Norway, the ranking of species from the most to the least tolerant was:

- Velvet bentgrass
- Creeping bentgrass
- Chewings fescue
- Slender creeping fescue
- Colonial bentgrass
- Annual bluegrass

In contrast, the lab. experiments testing tolerance to anoxia of plant material from the SCANGREEN plots at Landvik, Norway, showed Chewings fescue to be second to velvet bentgrass and that creeping bentgrass had the lowest tolerance of the species tested (annual bluegrass was not tested in this experiment). The ranking was:

- Velvet bentgrass
- Chewings fescue
- Slender creeping fescue
- Colonial bentgrass
- Creeping bentgrass



Experimental area for ice encasement was established at Apelsvoll, Norway 2021. Photo: Pia Heltoft.

Variety differences

Apart from the overall variation between species, there is always a certain variation between varieties within species. We have experienced that this variation is larger in the red fescues and colonial bentgrass than in creeping- and velvet bentgrass, perennial ryegrass, rough- and Kentucky bluegrass.

The lab experiments with 12 different varieties of creeping bentgrass showed the old variety 'Penncross' to have significantly higher tolerance to anoxia than the others. Similar comparisons for Chewings and slender creeping red fescue showed only few differences between the varieties, but Chewings fescue was generally more tolerant to anoxia than slender creeping red fescue.



Velvet bentgrass is superior in tolerance to ice encasement. From lab experiments at Landvik 2022 after 10 weeks of ice encasement. Plots 302 and 303 are colonial bentgrass, 304 and 305 are velvet bentgrass. Photo: Trygve Aamlid.

Winter tolerant species for tees and fairways



Kentucky bluegrass (in front to the right) versus perennial ryegrass (in front to the left) for football pitches at Kvithamar. Photo: Lars Nesheim

Kentucky bluegrass

For tees, fairways, sports fields and lawns, Kentucky bluegrass should be mentioned. While the challenge with this species is its slow development from seed, Kentucky bluegrass is among our most winter-tolerant turfgrass species. Traditionally, Kentucky bluegrass was considered intolerant to mowing heights below 25 mm, but our research shows that it tolerates closer mowing than previously expected. The widely used variety 'Limousine' has even performed well at 5 mm mowing height in the SCANGREEN trials. For these reasons, Kentucky bluegrass is highly recommended when growing-in new tees and fairways in tough winter climates. However, because of its slow germination and seedling growth, overseeding Kentucky bluegrass into established, live turf is usually wasted money.

We recommend using Kentucky bluegrass in a mixture with the most winter-hardy varieties of Chewings fescue, slender creeping red fescue and strong creeping red fescue when establishing fairways and tees on golf courses in severe winter climates.

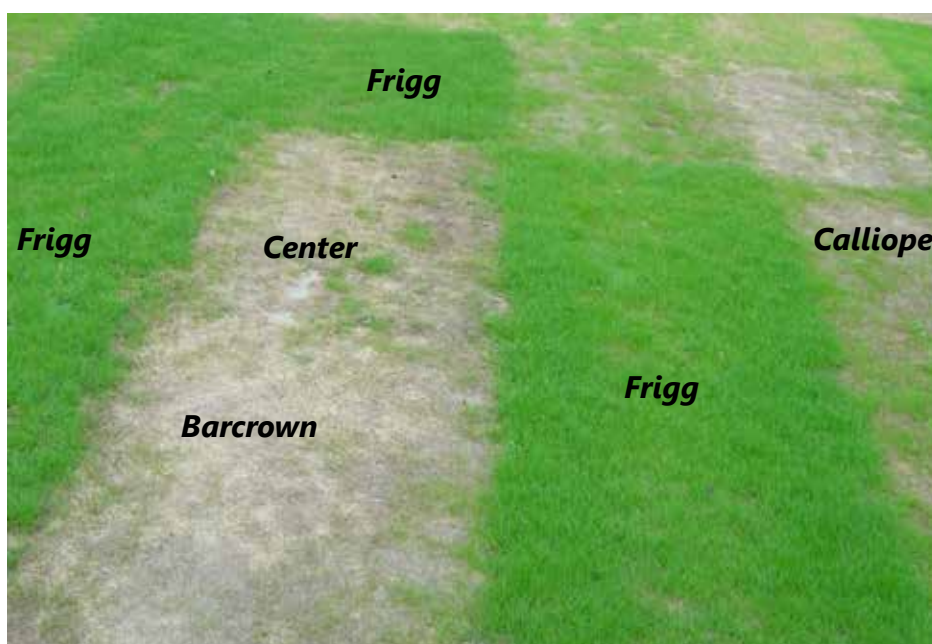
Strong creeping red fescue

Among varieties of strong creeping red fescue the Norwegian 'Frigg' is in a class of its own when it comes to overall winter stress tolerance. While this variety has a rather poor (dormant) winter color in areas without snow cover, it is highly recommended in seed mixtures for fairways and tees in winter-tough areas.

Concluding remarks:

The most devastating winter damage in the northern part of the Nordic countries is suffocation due to ice and water-ponding in winter and spring. In Denmark and in the southern part of Sweden the most severe winter injuries are related to microdochium patch either under snow cover or without snow cover when the weather is cold and moist.

When considering grass species, varieties and seed mixtures, local climatic conditions and access to use fungicides must be considered. The bentgrasses have good tolerance to ice and other physical stresses but are susceptible to snow molds. The fine fescues are less resistant to suffocation but will better resist winter diseases.



Experiment with winter survival at Hallingdal GC, Norway in late May showing excellent winter survival of strong creeping red fescue 'Frigg' compared to other varieties of red fescue. Photo: Ole M. Lilleby.



Photo: Agnar 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 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**

CANADIAN TURFGRASS RESEARCH FOUNDATION
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