

GRASS SPECIES AND VARIETIES for severe winter climates



Photo: Agnar Kvalbein

Introduction

This fact sheet will help you to choose the most winter-hardy grass species and varieties when establishing, re-seeding or over-seeding turf grass areas on golf courses and elsewhere in the Nordic countries. This fact sheet emphasizes golf greens, but we will also cover fairways, tees, sports fields and ordinary lawns. The description is limited to cool-season turf grasses.

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.

Summary

The most winter-hardy turf grass species for golf courses and other recreation areas that are not sprayed with fungicides to protect against snow moulds are smooth stalked meadowgrass (*Poa pratensis*), prostrate meadow grass (*Poa supina*), velvet bent (*Agrostis canina*) and Chewings fescue (*Festuca rubra* ssp. *commutata*).

If fungicides are used, creeping bent (*Agrostis stolonifera*) and brown top bent grass (*Agrostis capillaris*) is also very winter-hardy.

The species most susceptible to winter damage are perennial ryegrass (*Lolium perenne*) and annual meadow grass (*Poa annua*).

There is significant variation among varieties within most species and information about the most winter-hardy varieties are updated annually at www.scanturf.org and www.sterf.org.

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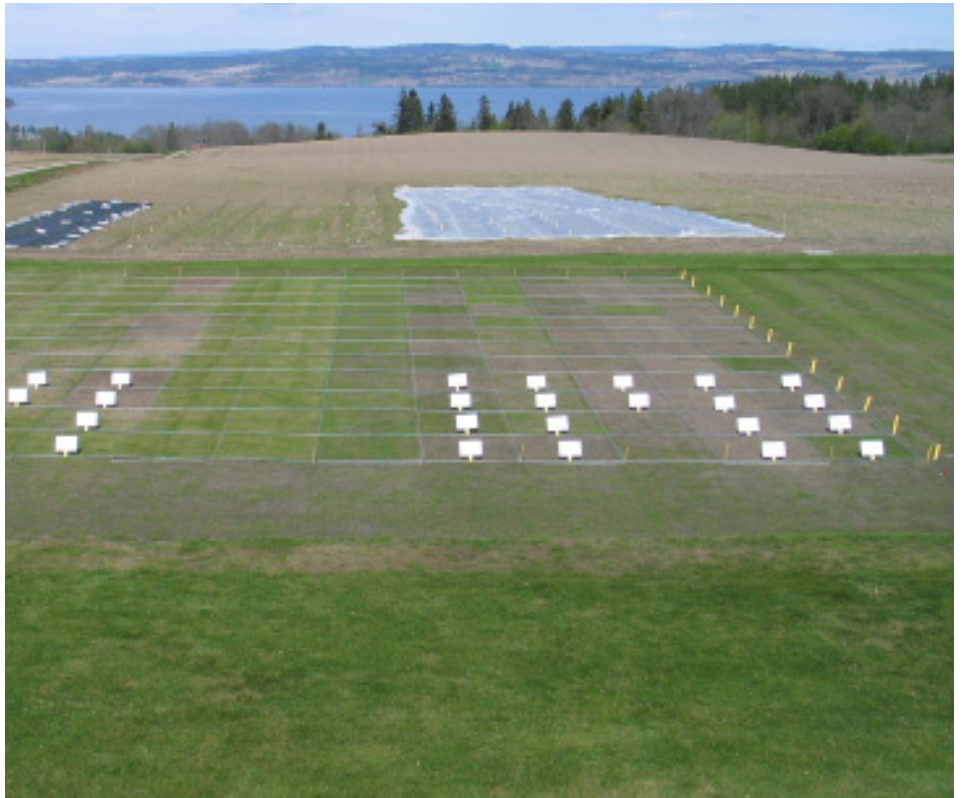
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Species, varieties and ecotypes

When a new variety is put on the market it is defined as a certain species. Most of the turf grass 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 in order to be acclimated.

Annual meadow grass (*Poa annua*) 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 important to know where the grass has been grown. Since annual meadow grass produces seed even at low mowing height, it is genetically flexible and will, over the years, adapt to the local climate and maintenance regimes.



Evaluation of turfgrass varieties for use on Scandinavian golf greens (SCANGREEN), Apelsvoll, Norway. Photo: Bjørn Molteberg.

Winter stress tolerance

There are several reasons why grass plants are injured or killed during the winter. Details about this are presented in other factsheets, but the different stresses can make it difficult to rank turf grass 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 mould. In most species there is a positive correlation between the ability to resist freezing, desiccation and ice encasement and the presence of winter-active fungi.

Winter stress tolerance is closely related to the acclimation status of the plant. When a grass plant is well acclimated and prepared for the winter, it has stop-

ped growing, some extra sugar has been stored for the winter, anti-freeze proteins have been produced inside the cells, and the cell membranes have been changed for improved stability under freezing and thawing conditions.

This acclimation status of the plant depends on environmental factors. The most important signal is temperature. A period of low temperatures in autumn will induce winter acclimation. Warm spells during the winter can de-acclimate the turf. The turf grass species vary in how sensitive they are to these warm periods.

The following ranking of grass species is first and foremost based on the evaluation of species and varieties at Nordic

locations over the last 15 years. The test programs include both coastal and inland climates at latitudes between 56 and 65 °N. Results about turf grass species are summarized in The Nordic Turfgrass Guide and in the lists of recommended varieties which are updated regularly at www.sterf.org and www.scanturf.org.

Some STERF research projects have also added specific knowledge about the species' freezing tolerance and ability to survive under different maintenance and climatic conditions.

Detailed reports can be found at www.sterf.org. Relevant information from this research is included in the text below.

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 pink snow mould (*Microdochium nivale*), grey snow mould (*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 bent grass (<i>Agrostis canina</i>)			Dark Red	Light Red					
2. Chewings red fescue (<i>Festuca rubra</i> ssp <i>commutata</i>)			Dark Red	Light Red	Light Red				
3. Prostrate meadow grass (<i>Poa supina</i>)			Dark Red						
4. Creeping bent grass (<i>Agrostis stolonifera</i>)			Light Red	Dark Red	Light Red	Light Red			
5. Brown top bent grass (<i>Agrostis capillaris</i>)		Light Red	Light Red	Dark Red	Light Red	Light Red			
6. Slender creeping red fescue (<i>F. rubra</i> ssp. <i>litoralis</i>)				Dark Red	Light Red				
7. Rough meadow grass (<i>Poa trivialis</i>)						Dark Red	Light Red		
8. Perennial ryegrass (<i>Lolium perenne</i>)						Light Red	Dark Red	Light Red	
9. Annual meadow grass (<i>Poa annua</i>)						Light Red	Light Red	Dark Red	Light Red

Winter hardiness of grass species under golf green conditions in the Nordic climate.

The length 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 bent grass (*Agrostis canina*)

Several research projects have confirmed that velvet bent is one of the most winter stress tolerant grass species for golf greens. It may be somewhat susceptible to *M.nivale* and other diseases during the growing season, but it usually resist snow moulds, especially *Typhula* sp., better than creeping bent grass when acclimated. In field tests it has survived 119 days under solid ice. There are just a few varieties on the market and the difference in winter hardiness is not significant except that 'Avalon' should be avoided in extreme winter climates.

2. Chewings red fescue (*Festuca rubra* ssp *commutata*)

This sub species of red fescue is ranked better than creeping bent grass for overall winter survival. This is mainly because it is less affected by snow moulds. Its freezing tolerance is, however, less than creeping bentgrass, and there is also some uncertainty related to its tolerance to ice

encasement. In unstable winter climates with high risk of ice build-up we would therefore rank creeping bent grass higher. Icelandic trials (65°N) are an exception where red fescue always has performed better than creeping bent grass, but this could also be related to the low summer temperatures and the dark winters with unstable snow cover and temperature fluctuations. On greens with good surface runoff chewings red fescue can be recommended as very winter stress tolerant. Be aware that some varieties, like 'Bellaire' or 'Calliope', do not achieve high scores for winter hardiness.

3. Prostrate meadow grass (*Poa supina*)

This species has been tested only for a few years, but it has been ranked among the most winter hardy species, especially on Iceland and in continental parts of Central and Northern Scandinavia. A light green colour and rather coarse sward are among the special characters of this species.

4. Creeping bent grass (*Agrostis stolonifera*)

This species generally has good winter survival, but most varieties are susceptible to snow moulds. This means that access to fungicides is a premise for successful winter survival of creeping bent grass. The old variety Penncross was top ranked at the most extreme test locations for many years, but new varieties like '007', 'T1', 'Independence' and 'Cobra Nova' now top the list. Some internationally popular varieties like 'Tye', 'Penn A-1' and 'Penn G-2' have showed poor winter survival in the Nordic inland climate.

Creeping bent grass has very good freezing tolerance and can resist suffocation under lasting ice encasement, but not for as long as velvet bent grass. In a field experiment comparing the ice encasement tolerance of various species on a golf green, creeping bent grass 'Independence' maintained 50 % coverage following 119 days of solid ice, whereas velvet bent grass 'Villa' maintained 90% coverage.



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

5. Brown top or Colonial bent grass

(*Agrostis capillaris* (=tenuis))

The Norwegian varieties 'Nor' and 'Leirin' of brown top bent have outstanding winter hardiness. Although 'Nor' has broad leaves and lower tiller density than most other varieties, these varieties can be recommended for golf courses that use a mix of bent and fescue in a tough climate. Otherwise, most varieties on the international market have less freezing tolerance and have less tolerance to pink snow mould than creeping bent grass. On the other hand, they are more resistant to grey snow mold. Popular varieties like 'Greenspeed' and 'Aberroyal' are ranked relatively low when it comes to winter survival.

6. Slender creeping red fescue (*Festuca rubra* ssp. *litoralis* (=ssp *trichophylla*))

This subspecies has several good characteristics (off-season colour, weed - competitive) that make it valuable on red fescue greens, although most varieties are slightly less winter hardy than the chewing fescues. The old, but still widely used variety, 'Barcrown', should be avoided on greens in locations with tough winter conditions.

7. Rough meadow grass (Rough bluegrass) (*Poa trivialis*)

Some Scandinavian greenkeepers have used this species to re-establish dead *Poa* greens in the spring. It germinates fast,

but persistency in greens has been poor under our conditions. The varieties on the market were developed for overseeding and winter play on Bermuda greens in the southern United States and Mediterranean areas, not for Nordic climates.

8. Perennial ryegrass (*Lolium perenne*)

This is not one of the main grass species on Nordic golf greens, but 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. It will probably take time to produce varieties that can both be classified as winter tolerant and with acceptable playing quality. Tetraploid ryegrasses are more resistant to snow moulds; they can be used on fairways, tees and roughs but they will not produce acceptable density at green's mowing height.

9. Annual meadow grass (*Poa annua*)

Very few commercial varieties have been tested in the Nordic countries and the winter stress tolerance has been very poor, both when it comes to ice encasement and pink snow mold. Most studies agree that the best freezing tolerance (LT_{50}) than can be achieved is in the range -10 to -14 °C. According to Canadian studies, there is, however, significant variation in winter hardiness among local ecotypes of annual meadow grass. The best ones may have winter survival superior to the best varieties of perennial ryegrass. Coastal and southern golf courses in the Nordic countries often have acceptable survival of annual meadow grass after use of fungicides in autumn.



Snow mould can harm creeping bent grass, especially when snow fall in spring occurs when the turf has started growing. Photo: Tatsiana Espevig, Landvik, Norway, spring 2008.

Winter tolerant species for other turfgrass areas

One of the most winter hardy grass species on the market is tufted hair-grass (*Deschampsia cespitosae*). On a golf course it will sometimes appear naturally on moist fairways or roughs and cause unacceptable tufts.

For tees, fairways, sports field and ordinary lawns, smooth stalked meadow grass (=Kentucky bluegrass, *Poa pratensis*) should be mentioned because of its excellent winter survival. The challenge with this species is its slow development from seed, but when established it will resist all winter stresses very well. Under Nordic temperature and light conditions it has also proven to tolerate lower mowing than expected based on American literature. This species should therefore be seeded into both tees and fairways when establishing a golf course. It can be very challenging to introduce this species into established turf.



One of the most winter hardy grass species on the market is tufted hair-grass (*Deschampsia cespitosae*). Photo: Trygve Aamlid.

Choosing species and varieties

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 the southern part of Sweden the most severe winter injuries are related to *Microdochium nivale* which cause pink snow mould under snow cover or microdochium patches (referred to as Fusarium by many greenkeepers) when the weather is cold and moist.

When choosing grass species the local climatic conditions must be taken into consideration. The bent grasses have good tolerance to ice and other physical stresses, but are susceptible to snow moulds. The fine fescues are less resistant to suffocation, but will better resist winter diseases. The access to fungicides will most likely be limited in the future and this should be taken into account when a golf course is constructed and grass species chosen.

Since there are considerable differences within the fescue and bent grass species and subspecies, it is always crucial to order the best varieties based on test results from areas with similar climate.



Microdochium nivale at snowmelt in the trial at Apelsvoll, Norway, March 2014. Photo: W. Waalen.



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Read more

Aamlid, T.S., G. Thorvaldsson, F. Enger & T. Pettersen. 2012. Turfgrass species and varieties for Integrated Pest Management of Scandinavian putting greens. *Acta Agriculturae Scandinavica Section B Soil & Plant Science* 62 (Supplement 1): 10-23.

Aamlid, T.S. & V. Gensollen 2014. Recent achievements in breeding for turf quality under biotic and abiotic stress. In: Sokolovic, D., C. Huyghe & J. Radovic (eds.). *Quantitative traits breeding for multifunctional grasslands and turf*. Springer Science + Business Media, Dordrecht. pp. 189-196.

Aamlid, T.S., W. Waalen, G. Thorvaldsson, A.M.D. Jensen, T. Esepvig, T. Pettersen, J. Tangsveen, A. A. Steensohn, P. Sørensen & B. Hannesson 2015. *SCAN-GREEN 2011-2014: Turfgrass species and varieties for Integrated Pest Management of Scandinavian putting greens*. *Bioforsk Report* 10(65): 1-91.

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Kvalbein, A. & T.S. Aamlid 2015. *The Grass Guide 2015: Amenity turf grass species for the Nordic countries*. Scandinavian Turfgrass and Environment Research Foundation. (Available at www.sterf.org)

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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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/**