



THE GRASS GUIDE 2012

AMENITY TURF GRASS SPECIES
FOR THE NORDIC COUNTRIES



Sterk

PREFACE

The Grass Guide 2012 presents research and experience of amenity turf over the past 30 years. Most of the material is taken from the testing of varieties in Norway, but some material from other Nordic countries is also included.

This report only reviews different grass species, and the recommendations made are on a fairly general basis. When selecting grass seed mixtures for high quality applications, information should be taken from the Variety Guide, which is available on the internet (<http://sterf.golf.se> and www.scanturf.org). The Variety Guide ranks different grass varieties based on overall visual impression or specific qualities such as tiller density, texture, i.e. fineness of the leaves, colour, tolerance to winter stress, disease resistance, wear tolerance, growth rate etc. The information provided is based on research carried out at a number of locations in the Nordic countries and there are separate tables for the various species used for green (mowing height 6 mm and lower) and ordinary lawns (including tolerance to wear and mowing at 7-20 mm). The production of The Grass Guide 2012 was funded by the Scandinavian Turfgrass and Environment Research Foundation (STERF): <http://sterf.golf.se>.

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INTRODUCTION

The Grass Guide 2012 is intended to help growers find the best grass species to meet their specific needs. Living grass can be used for a number of purposes other than food production and building material, for example as protection against erosion, re-vegetation after construction work in nature, ground cover for alpine ski slopes or camping sites, aesthetic elements of amenity turf, lawns, grassland and as a surface for different ball games.

This review concerning amenity turf only deals with grass-covered slopes, lawns, football pitches and golf courses. These different environments are characterised by different mowing frequency, degree of wear and mowing height.

The Nordic countries also have varying climate conditions and soil types. The amenity grasses described here have been tested at different locations and there are considerable differences in how the species cope, for example in Iceland compared with Southern Sweden or inland Scandinavia. These differences are described in more detail on variety level.

Choosing the right grass species is important in order to achieve good results, but different species have different maintenance requirements. It is not sensible to choose a grass species that can achieve the best result if the operating budget is too small to exploit the full

potential of this particular species. This can actually prove to be worse than choosing a species that requires less care.

This Grass Guide 2012 is not a grass flora and thus we do not place high emphasis on botanical descriptions of the grass species included. However, we do highlight characteristics that are important for the value of amenity turf.

Within each species, there are different varieties which are currently being marketed. A variety is usually refined from several different ecotypes of a grass species. Therefore varieties can differ slightly from the description of species, subspecies and ecotypes provided in a grass flora.

Because there are constantly new and better varieties on the market, a description of the varieties is not included in this guide. However, such descriptions are available at www.scanturf.org and <http://sterf.golf.se> in a format that is more easy to use and update.

The Grass Guide 2012 is intended for professionals and therefore it does not include an introduction to the grass plant in general or explanations of technical terms along the way. However, a glossary is included. The primary target group is professionals responsible for amenity turf.

GRASS SPECIES FOR AMENITY TURF

A quick overview of the grass species recommended for amenity turf is provided in the Table 1, which presents grass species used in different applications in parks, and Table 2, which presents species used in various types of sports grounds. Grass species with specific qualities are presented in Table 3. Following these tables, a description is provided of species that are of current interest.



Table 1. Recommended grass species for lawns and parks

Botanical name	English (UK) name	Ornamental lawn	Lawn for recreation	Hard wear lawn	Shaded lawn	Utility turf
<i>Agrostis canina</i>	Velvet bent					
<i>Agrostis capillaris</i>	Common bent	X	X			X
<i>Agrostis stolonifera</i>	Creeping bent					
<i>Dechampsia caespitosa</i>	Tufted hair-grass				X	
<i>Festuca ovina</i>	Sheep's fescue					X
<i>Festuca rubra</i>	Red fescue	X	X			X
<i>F.rubra ssp. commutata</i>	-chewings r.f.	X	X		X	X
<i>F.rubra ssp. litoralis</i>	-slender creeping r.f.	X	X		X	
<i>F.rubra ssp. rubra</i>	-strong creeping r.f.	X	X		X	X
<i>Festuca trachyphylla</i>	Hard fescue					X
<i>Lolium multiflorum</i>	Westerwolds ryegrass			X		
<i>Lolium perenne</i>	Perennial ryegrass		X	X		
<i>Poa annua</i>	Annual meadow-grass *					
<i>Poa pratensis</i>	Smooth meadow-grass	X	X	X		
<i>Poa supina</i>	Creeping meadow-grass			X		
<i>Poa trivialis</i>	Rough meadow-grass				X	

* Annual meadow-grass is spread with soil and contaminated seed lots, and later by on-site seed production. It is rarely seeded.

FOOTBALL PITCHES



GOLF COURSES



Table 2. Recommended grass species for football pitches and golf courses

Botanical name	English (UK) name	Football pitch	Green	Tee	Fairway	Cut rough	High rough
<i>Agrostis canina</i>	Velvet bent		X				
<i>Agrostis capillaris</i>	Common bent		X		X	X	X
<i>Agrostis stolonifera</i>	Creeping bent		X	X	X		
<i>Dechampsia caespitosa</i>	Tufted hair-grass	X		X			
<i>Festuca ovina</i>	Sheep's fescue						X
<i>Festuca rubra</i>	Red fescue						
<i>F.rubra ssp. commutata</i>	-chewings r.f.	X	X	X	X	X	X
<i>F.rubra ssp. litoralis</i>	-slender creeping r.f.	X	X	X	X	X	X
<i>F.rubra ssp. rubra</i>	-strong creeping r.f.	X		X	X	X	X
<i>Festuca trachyphylla</i>	Hard fescue						X
<i>Lolium multiflorum</i>	Westerwolds ryegrass	X					
<i>Lolium perenne</i>	Perennial ryegrass	X		X			
<i>Poa annua</i>	Annual meadow-grass *						
<i>Poa pratensis</i>	Smooth meadow-grass	X		X	X	X	
<i>Poa supina</i>	Creeping meadow-grass	X		X			
<i>Poa trivialis</i>	Rough-stalked meadow-grass		X*				

* For temporary repair only.



Table 3. Qualities of grass species used for amenity turf ranked on a scale of 1 to 9, where 9 indicates largest/best. The species annual meadow-grass, Westerwolds ryegrass, rough meadow-grass and creeping meadow-grass have only been tested to a limited extent in comparable research in the Nordic countries

Botanical name	English (UK) name	Establishment rate	Tiller density	Fineness of leaves	Winter hardiness	Winter colour	Nutrient demand	Lateral growth	Wear tolerance	Resistance to in-season diseases	Mowing tolerance	Shade tolerance	Drought tolerance	Salt tolerance
<i>Agrostis canina</i>	Velvet bent	7	9	7	7	8	4	3	5	4	8	6	7	4
<i>Agrostis capillaris</i>	Common bent	6	6*	5*	6*	4	5	5	3	3	7	6	3	2
<i>Agrostis stolonifera</i>	Creeping bent	6	8	5	6	4	7	8	5	5	8	4	3	5
<i>Dechampsia caespitosa</i>	Tufted hair-grass	3	5	4	8	4	6	1	5	9	3	8	3	4
<i>Festuca rubra</i>	Red fescue													
<i>F.r. ssp. commutata</i>	- chewings r.f.	4	6	7	7	4	4	1	4	8	5	7	6	6
<i>F.r. ssp. litoralis</i>	- slender creeping r.f.	4	6	7	5	6	4	3	5	7	5	7	7	7
<i>F.r. ssp. rubra</i>	- strong creeping r.f.	4	4	6	5*	5*	4	5	3	6	4	7	8	6
<i>Festuca ovina</i>	Sheep's fescue	2	6	8	5*	4	2	1	1	7	4	6	8	5
<i>Festuca trachyphylla</i>	Hard fescue	3	6	7	5	4	2	1	1	7	4	6	9	5
<i>Loium multiflorum</i>	Westerwolds ryegrass	9	3	4	1	8	8	2	8	7	3	5	5	8
<i>Lolium perenne</i>	Perennial ryegrass	8	4	5	3	7	8	2	8	7	4	5	6	8
<i>Poa annua</i>	Annual meadow-grass	8	5	5	2	5	8	3	4	2	7	6	1	2
<i>Poa pratensis</i>	Smooth meadow-grass	2	3	3	8	4	7	8	7	6	2	3	4	3
<i>Poa supina</i>	Creeping meadow-grass	5	5	5	6	4	7	8	7	6	5	7	4	3
<i>Poa trivialis</i>	Rough meadow-grass	7	6	7	3	8	6	5	3	5	7	8	3	3

* Great variation within varieties. Norwegian amenity turf varieties have lower tiller density, broader leaves, better winter hardiness and less winter greenness than foreign varieties.

REVIEW ALPHABETICALLY BY LATIN NAME



Variety testing on Iceland. Photo: Gudni Thorvaldsson

GRASS SPECIES AND VARIETIES

The botanical classification of grass plants is complicated, and names and divisions vary from one flora to another. Botanical names other than those mentioned in this Grass Guide 2012 may therefore occur.

Grass plants belong to the same species if they can pollinate each other and develop fertile seeds. There will always be variation within each species in nature. Botanists talk about subspecies, varieties, populations or ecotypes that are adapted to local conditions.

Plant breeders collect plants and cross them into new varieties, which are then tested, approved and finally multiplied for sale as commercial seeds. For a variety to be approved and legally protected in terms of plant breeder's rights, there must be documentary evidence that it can be distinguished from other varieties, and that it is sufficiently uniform and stable under propagation. Within the same species, there may thus be varieties that differ from the plants found in nature.

It is always important to choose the best varieties within each species, because there can be considerable differences in terms of tiller density, fineness of leaves, summer colour, winter colour, tolerance to winter stress, resistance to disease, wear tolerance and the ability to tolerate close mowing. When comparing varieties, these characters are usually summarised into a score for overall visual impression, which is used to rank the varieties from the best to the worst. At the websites www.scanturf.org and <http://sterf.golf.se>, you will also be able to rank varieties for specific characters, if you consider some characters more important than others for your area of use.

Many countries have restrictions on the import and use of exotic grass species and varieties in natural areas. Defining what is exotic can be an issue, but in general it is recommended to use plant material originating near the area to be seeded. This ensures winter hardiness and prevents the turf from differing too much from the surrounding natural environment.

Agrostis canina L.

	Velvet bent
	Velvet bentgrass
	Brunven
	Hundehvene
	Hundekvein
	Lutharölli
	Týtulingresi

Velvet bent is found throughout the Nordic region in moist habitats, water edges and marshes, where it forms open tufts. In amenity turf the species is only used on golf greens, where it forms a denser turf than any other grass species. The colour is intense, bright green.

Velvet bent's growth rate is lower than that of creeping bent and the nutrient demand is not as high. The water consumption is slightly less than for other grass species, and it keeps an attractive colour and quality even during dry periods. Height growth per day is low and, together with high tiller density, this contributes to high green speed. The only drawback that would make us reluctant to recommend velvet bent is that it produces a thatch that can be difficult to maintain. The turf is so dense that dressing sand scarcely sinks in. This

can easily result in soft greens, and in the worst case massive fungal attacks. Velvet bent does not grow laterally on greens and thus has weak ability to re-cover worn areas. Ball marks on the greens can therefore be a problem with frequent use.

Velvet bent is at least as susceptible to fungus diseases during the growing season, e.g. *Microdochium* patch, as creeping bent. However, it is less affected by snow mould in the winter. Winter hardiness is an important quality of this species. Its competitive ability against weeds is also good, and even annual meadow-grass can be outcompeted in velvet bent greens. The species has not been tested outside golf greens, but today we do not know of any other areas of use. There are not many varieties to choose from, and the marketing of seeds has been limited.

Golf courses in Finland have experience of this species, but it has scarcely been used in the other Nordic countries over recent years. Some golf courses have tried velvet bent mixed with red fescue. These species fit well together when it comes to fertilisation level and irrigation strategy. The reason for combining them is to improve the winter colour of the red fescue greens or to make the greens less firm. The challenge lies in getting a consistent sward mix if soil moisture and light conditions vary on and between the greens.

The seeds of velvet bent are small (15 000 seeds per gram) and the seeding depth should not exceed 2-3 mm.



Kytäjä GK, Finland.

Agrostis capillaris L. (= Agrostis tenuis SIBTH.)

	Common bent / Browntop bent
	Colonial bentgrass
	Rödven
	Almindelig hvene
	Engkvein
	Nurmirölli
	Hálingresi

Common bent is a common grass species on moist and barren soils throughout the Nordic countries, especially in grazing areas. Common bent can be found at over 1300 m above sea level.

This grass species is not widely used in amenity turf outside northern Europe, and the number of varieties is therefore few. Common bent produces short runners above and below the soil surface and can form a dense sward. The colour usually appears somewhat dull.

If it is not cut below 15 mm, the common bent sward can be fluffy and brownish at the base. This happens because the apex is pushed up so that the green leaves are not formed at the surface, but at some distance above the surface. Moreover, many varieties easily form panicles (stalks) that reduce its overall impression in fairways and lawns. The wear tolerance of common bent is usually low.

Common bent is very susceptible to fungal diseases and its winter hardiness is variable. Norwegian varieties have good winter hardiness and should be considered for use in seed mixtures for fairways and ornamental lawns in regions where the winters are long and hard.

It is customary to sow a mixture of red fescue and common bent on greens in the Nordic countries. These two species are complementary, as both have relatively low fertiliser requirements, but common bent thrives better than red fescue on moist soil. The species that subsequently becomes dominant is determined by environment, and the species composition

may change depending on weather, soil conditions and mowing height. Common bent copes better than red fescue with a very low cut (3 mm). As the leaves grow upwards, common bent also requires a low cut in order to give a good ball roll. Greens dominated by common bent produce more thatch and are slightly softer than red fescue greens.

Take-all patch, snow mould, *Microdochium* patch and other diseases attack common bent more than red fescue, and red fescue tends to dominate in old patches caused by disease.

On fairways, common bent can form a very dense turf, which thrives well in moist areas. The inflorescence of common bent is red to purple. On grass-covered slopes and uncut roughs the swaying panicles give a pleasant aesthetic impression, but the sward under the straws becomes denser than a corresponding sward of red fescue.

The seeds of common bent are small (10 000-15 000 seeds per gram) and having common bent seeds in the seed mixture can result in too many plants. In green mixtures, 10% common bent and 90% red fescue give rise to roughly the same number of plants of each species. In mixtures for fairways and fine lawns, common bent should not constitute more than 5%.

Common bent germinates and establishes relatively quickly, but like other bent species it is vulnerable to drought in the germination stage. It should be sown at shallow depth.



Rauma GK, Norway.

Agrostis stolonifera L.

	Creeping bent
	Creeping bentgrass
	Krypven
	Krybende vhone
	Krypkvein
	Rönsyrölli
	Skiðlingresi

This species is found wild all over the Nordic region. It is most common along the coast, but can be found up to 1000 m above sea level. Creeping bent naturally grows laterally, forming stolons. This enables the species to repair damage in the sward easily.

However, because of the stolons and the generally high growth rate, creeping bent may create much thatch that must be controlled through intensive maintenance. Creeping bent is often used on golf greens because the species tolerates low mowing (3 mm). The mowing height can be kept low even during the autumn.

The good recuperative capacity makes creeping bent relevant also on tees and fairways. If seeded on the fairway the operating budget of the golf course must be large enough to allow for regular vertical cutting to avoid the development of horizontally growing grass.

On sand-based fairways, regular sand dressing is important to avoid harmful thatch.

Creeping bent should be cut lower than 10 mm to be kept fine. Frost tolerance is good and creeping bent does relatively well under a stable ice cover (100-120 days), but it can be prone to attack by fungal diseases in the winter and in the summer. It is therefore difficult to keep this species free from diseases without using fungicides.

Breeding of new varieties of creeping bent has mainly taken place in North America, and there are major differences among varieties when it comes to aggressiveness and density. 'Penncross' was released in 1995 and it is still one of the world's most widely used varieties. It is moderately dense, but has long stolons and thus a good capacity for repair. Varieties from the two last decades, many of them with twice as high tiller density as 'Penncross', usually require a different management program to avoid thatch. American breeders are now mostly breeding for disease resistance and stress tolerance, but so far, they have not been focusing on the most common diseases on golf courses in the Nordic countries.

The seeds of creeping bent are small (10 000-15 000 seeds per gram). They should thus be sown at a depth of 2-3 mm. When the seeds germinate, consistent moisture is important. In Iceland, creeping bent has not demonstrated acceptable quality in variety testing. In the Nordic countries it is uncommon to seed creeping bentgrass in mixtures with other grasses, but it is common to use a blend of different creeping bent varieties with uniform colour and leaf fineness.



Variety testing on Iceland. Photo: Gudni Thorvaldsson

***Deschampsia caespitosa* L.**

	Tufted hair-grass / tussock grass
	Tufted hairgrass / tussock grass
	Tuvtåtel
	Mosebunke
	Sølvbunke
	Nurmilauha
	Snarrótarpuntur

Tufted hair-grass grows all over the Nordic region and can be found up to 1470 m above sea level. The species has stiff, silica-containing leaves and forms dense tufts on moist places in nature.

Tufted hair-grass is marketed because it can provide a dense sward even in shady places.

During testing, the species has often been compared to smooth meadow-grass. Tufted hair-grass establishes almost as slowly as smooth meadow-grass, but it

forms a denser turf. The winter hardiness is at least as good as that of smooth meadow-grass and it is seldom attacked by fungal diseases. Wear tests have shown that the wear tolerance is comparable to that of intermediate to good varieties of smooth meadow-grass. However, tufted hair-grass does not spread laterally and the recuperative capacity is therefore inferior to that of smooth meadow-grass. The colour is lighter than for most varieties of smooth meadow-grass and ryegrass, and the high silica content can make the plants feel a little prickly.

Tufted hair-grass can produce a good plant population under the shade of deciduous trees.

The species has been tested in mixtures with other species. Mixtures with smooth meadow-grass or red fescue with short or long runners are more stable over time than mixtures with other tuft-forming species such as ryegrass and chewing fescue.

The strong tendency for producing tufts makes it necessary to keep the mowing height of tufted hair-grass low (below 40 mm) to obtain a good result. On the other hand, the species does not tolerate mowing below 10 mm, so it is primarily an alternative for shaded lawns. Dull mowers can give a white tinge to the sward.



Fairway trials at Fullerö GK, Sweden, June 2008.

***Festuca rubra* L.**

SUBSPECIES: *F. rubra* ssp. *rubra*, *F. rubra* ssp. *litoralis* (= *F. rubra* ssp. *trichophylla*), *F. rubra* spp. *commutata*

	Red fescue (subspecies called respectively 'strong creeping red fescue', 'slender creeping red fescue' and chewings fescue).
	As UK, but often uses the collective term 'fine fescues', which also includes hard fescue and sheep's fescue.
	Rödsvingel
	Rødsvingel
	Rødsvingel
	Punanata
	Tunvingull

Red fescue can be divided into other subspecies than those mentioned in this Grass Guide. The division shown above was chosen because it is customary to refer to subspecies with a descriptive supplement: red fescue without/with short or long runners. Varieties in these subspecies also differ from each other in terms of tiller density, colour and winter hardiness.

Red fescue has narrow, almost thread-like leaves and is found in nature in many different habitats, for example sparse forests, meadows and roadside verges, but prefers dry areas. As the growth rate is low, red fescue is most competitive with other species in relatively nutrient-poor areas. Therefore it is not considered particularly tolerant to wear. However, red fescue has wide applications in amenity turf. When uncut, it develops beautiful, red-brown inflorescences. Red fescue can be cut at 5 mm and produces dense lawns with short mowing. The species performs relatively well in the shade.

The subspecies chewings fescue, which in nature grows in dense tufts, is originally from South and Central Europe. It is considered to grow wild in Denmark and Skåne, but has been scattered with lawn seed all over the Nordic countries. Chewings fescue has narrow leaves, forms dense swards and is suitable

for greens, ornamental lawns and grass-covered slopes. The winter hardiness is very good, and likewise the resistance to disease. It has a nice, deep green colour, but may lose colour during dry periods.

The subspecies slender creeping red fescue belongs to beach meadows, in other words a slightly humid environment that is exposed to salt. The short rhizomes enable this subspecies to repair damage better than chewings fescue. The colour is normally lighter green and the winter colour is greener, but the winter hardiness is a little weaker than for chewings fescue.

The subspecies strong creeping red fescue grows naturally all over the Nordic region and can be found at more than 1 800 m above sea level. The long rhizomes provide a sparse grass stand and it is therefore not suitable for greens. However, this subspecies retains its colour better than the other two subspecies during dry periods, and is thus relevant in seed blends with the two other subspecies for fairways and lawns.

There are significant differences in red fescue varieties when it comes to tiller density and winter hardiness. Norwegian varieties of strong creeping red fescue have good winter hardiness and are therefore useful for ornamental lawns in northern and inland areas of the Nordic countries.

Red fescue is well known to golfers from Scottish links courses. The species thrives in this nutrient poor, well-drained environment. Greens with pure red fescue may become firm because the species only produces moderate amounts of thatch. The thin leaves result in low rolling resistance and the ball roll can be good even if the mowing height is not lower than 5 mm. Fairways dominated by red fescue repair divots slowly and regular overseeding might be necessary under excessive wear.

Red fescue is easily attacked by red thread disease, but is otherwise resistant to the most common fungal diseases. The species is therefore a good option for reduced use of chemical fungicides. A deep root system (brown roots) enables the grass to survive through dry



First row: Red fescue (left) is less tolerant to wear than ryegrass (right). Second row: Same species without any wear. Testing done at Landvik, Norway, August 2009.

periods. The nutrient demand is low, and altogether this makes red fescue an economical alternative where there are not particularly high demands on wear tolerance and recuperative capacity.

Seeds of red fescue are relatively large (600-1000 seeds per gram), but even with a good supply of moisture the establishment rate is still lower than for the bent species.

The area of application is wide. Red fescue is a good choice for ornamental lawns and ordinary lawns, high rough, grassy slopes and grass roofs.



*Checking out winter damages, mostly fungal diseases, at Landvik, Norway, spring 2010. From front to back: tall fescue (*Festuca arundinacea*), smooth meadow-grass (good overwintering) and ryegrasses. The partition in the middle, with good overwintering, is red fescue.*

***Festuca trachyphylla* HACK.**

	Hard fescue
	Hard fescue (see comment above for red fescue)
	Hårdsvingel
	Stivblandet svingel
	Stivsvingel
	Jäykkänata

These two species both produce dense tufts and have a grey to green colour. There are several sub-species. In more elevated and northern parts of Scandinavia sheep's fescue is considered to grow wild, but hard fescue is scattered along the roads after seeding.

Both species establish slowly, are short in stature, have modest fertilizer requirements and are very tolerant to drought, but they do not tolerate much wear. They have not been tested on greens, but tests show that

***Festuca ovina* L.**

	Sheep's fescue
	Sheep's (see comment above for red fescue)
	Fårsvingel
	Fåresvingel
	Sauesvingel
	Lampaannata
	Sauðvingull

they tolerate mowing down to 7 mm. Nevertheless, it is common to assume that they thrive best in dry, extensive grassed areas, such as grass roofs. They manage relatively well in the shade. These two species are often referred to simultaneously because they have similar areas of use. There are not many varieties for sale.

Hard fescue contains about 1200 seeds per gram and sheep's fescue about 2000 seeds per gram.

***Lolium multiflorum* LAM.**

	Italian ryegrass / Annual ryegrass
	Italian ryegrass / Annual ryegrass
	Italienskt rajgräs
	Rajgræs, italiensk
	Italiensk raigras
	Italianraiheinä
	Ítalskt rýgresi

Italian ryegrass is an annual, biannual or short-lived perennial species that forms loose tufts.

Some consider it to be a subspecies of *Lolium perenne*, with which it can be crossed (hybrid ryegrass). Within this species purely annual varieties have been produced. These are named Westerwolds ryegrass.

Italian ryegrass has long been used in fodder production, but now there are varieties with narrower and thinner leaves, which are suitable for the amenity turf market. These varieties can be used where there is a need for quick, temporary establishment of grass cover that will almost certainly die back during the winter. The foremost advantage of Italian ryegrass is its fast establishment from seeds. Otherwise, the qualities are very similar to those of perennial ryegrass.

***Lolium perenne* L.**

	Perennial ryegrass
	Perennial ryegrass
	Engelskt rajgräs
	Engelsk rajgræs
	Flerårig raigras
	Englanninraiheinä
	Túnrúggresi

Perennial ryegrass forms loose tufts. The leaves have a fresh green colour throughout the year and a shiny underside. This is the world's most widely used grass species for amenity turf in temperate climates and the supply of varieties is immense.

There are large differences in colour, with some breeders in the United States producing very dark varieties.

Perennial ryegrass plants have a high growth rate and wear tolerance, but they do not grow laterally. Damage to the sward must thus be repaired by reseed-

ing. Perennial ryegrass does not cease growth in the autumn to the same extent as winter hardy species do, and individual plants may therefore appear as strongly growing tufts among the other grass species. Perennial ryegrass easily forms seed stalks. These characteristics enhance the need for regular mowing, even during the autumn. The strong fibres of the leaves require sharp cutting knives in order to prevent peeling and grey leaf tips.

Perennial ryegrass has poor winter tolerance and will often die out in the inland of the Nordic countries. However, it will normally survive in southern areas and along the coast. It is difficult to determine where this borderline is, as the winters are so different. Unfortunately there are only small differences between varieties when it comes to winter hardiness.

The great wear tolerance makes perennial ryegrass an important component of football turf. Where winter hardiness is important, perennial ryegrass should be used together with smooth meadow-grass.

On golf courses perennial ryegrass is primarily used to repair tees, but it can also be considered for use on high-traffic areas, such as bridge passages on fairways and at the entrance to tees. Use of perennial ryegrass is normally not recommended for greens' surroundings and fairways because it may form tufts, leading



There has been a tendency among grass breeders, especially American companies, to breed darker ryegrass varieties. One of the consequences is that it is easier to spot invasion of annual meadow-grass. Landvik, Norway, 2008.



The strong fibres of the ryegrass leaves require sharp cutting knives in order to prevent peeling and grey leaf tips.

to randomness.

Perennial ryegrass can be seeded in an attempt to repair winter-damaged greens. For successful results, it is important to use varieties that do not tolerate low mowing for extended periods. Otherwise, perennial ryegrass could become dominant on the green and result in new winter damage.

In winter-mild parts of the Nordic countries perennial ryegrass can be considered for use in parks, especially in areas with high wear. Regular overseeding should form part of the maintenance programme in high wear areas to prevent injured turf being invaded by annual meadow-grass.

Perennial ryegrass shows strong resistance to in-season diseases, but red thread disease often occurs if fertiliser inputs are too low.

Perennial ryegrass has large seeds (500 seeds per gram) and it germinates quickly and under drier conditions than most other species. The species is therefore often used in seed mixtures to repair sward damage. However, because of the negative characteristics mentioned above, perennial ryegrass should only be included in seed mixtures after careful consideration of the long-term consequences.



Winter damaged perennial ryegrass. Landvik, Norway, spring 2011.

***Poa annua* L.**

	Annual meadow-grass
	Annual bluegrass
	Vitgröe
	Enårig rapgræs
	Tunrapp
	Kylänurmikka
	Varpasveifgras

Annual meadow-grass originated in Europe, but has spread as a weed all over the world. The plant is light green, usually forming flat tufts, and it can bloom all year round as long as there is no frost. It is extremely adaptable to different environments.

Annual meadow-grass is referred to as an annual to biennial plant, but one subspecies, *Poa annua* var. *rep-tans*, is perennial and spreads by short rhizomes. Important characteristics of annual meadow-grass in amenity turf are its shallow root system, high susceptibility to several fungal diseases and poor winter hardiness.

We do not recommend seeding annual meadow-grass, as there are no varieties on the market with sufficient qualities documented. However, annual meadow-grass establishes as a weed in all types of short cut grass areas. This is due to the fact that the species has an amazing ability to produce seeds capable of germinating under poor conditions. It also has a high growth rate and the ability to compete with other grass species.

Seeds of annual meadow-grass are efficiently spread via contaminated grass seed or soils, and later by shoes and equipment.

Annual meadow-grass sprouts easily in voids in the sward even under unfavourable germination conditions. It manages well in areas where desirable grass species do not thrive; such as trampled or poorly drained areas. These annual meadow-grass areas often

appear to be completely dead in the spring, but new seeds germinate from the seed bank in the soil and form a dense sward during June.

Annual meadow-grass is well adapted for golf greens. It tolerates very low mowing and many of the world's best golf courses have annual meadow-grass greens. On old annual meadow-grass greens, perennial and creeping types can often be found. The annual types have a distinct flowering period in the beginning of June.

Maintenance of annual meadow-grass requires much fertiliser, frequent irrigation and use of chemical pesticides. Therefore it is expensive to keep annual meadow-grass of high quality.

Annual meadow-grass is accepted as a favourable grass species for greens in many countries where winter injury is not common. However, in the Nordic countries, with our harsh winters, it is recommended to combat annual meadow-grass as much as possible. The seed remains capable of germinating for nearly ten years in the soil, so when renovating turf, it is important to remove the top layer containing annual meadow-grass seeds.



Poa annua

Poa pratensis L.

	Smooth meadow- grass
	Kentucky bluegrass
	Ängsgröe
	Engrapgræs
	Engrapp
	Niittynurmikka
	Vallarsveifgras

Smooth meadow-grass has the typical characteristics of the genus Poa. The leaves are broad all the way to the leaf tip, which is shaped like the bow of a boat.

Typical features of smooth meadow-grass are its dark, almost blue-green, colour and strong rhizomes. There are many different forms in nature, but unlike in red fescue, they are not referred to as botanical subspecies. Smooth meadow-grass in amenity turf has relatively broad leaves and the tiller density is generally low, although there are large differences among varieties. Under the soil surface rhizomes make the turf strong and able to recover quickly from damage. The winter hardiness is very good.

Smooth meadow-grass thrives on fertile, clay soil and in agriculture it is recommended that the pH be kept above 6 for this species. The resistance to snow mould is good, but several leaf diseases can attack during the summer, including powdery mildew (*Blumeria graminis* spp. *poae*, formerly *Erysiphe graminis*), melting-out disease (*Drechslera poae*) and rust (*Puccinia poae-nemoralis*). Rust in particular can reduce the quality of grass in southern parts of the Nordic countries, but it is rarely necessary to use fungicides. There are large differences in varieties when it comes to resistance to disease.

Traditionally, low mowing of smooth meadow-grass is not recommended. The lowest mowing height that can be tolerated is, however, subject to discussion and

again, there appear to be differences between varieties. In research performed in the US, some new varieties were rated better at 12 mm mowing height than at 25 mm. Earlier recommendations for a minimum mowing height of 16-20 mm were based on experiences with more heat stress, significantly higher disease pressure and more fertiliser than is common in the Nordic countries. Provided a bright, cool climate and steady, moderate fertiliser levels, our opinion is that new, dense and fine-leaved varieties of smooth meadow-grass tolerate a mowing height of 10 mm. Low mowing may, however, be stressful to smooth meadow-grass growing on football pitches, where large production of rhizomes is more important and light conditions are poorer.

Smooth meadow-grass establishes slowly. The seeds are relatively small (3 000-5 000 seeds per gram) and it takes time to establish a dense vegetation cover. Because of the slow establishment, annual meadow-grass can easily become dominant. Sodding is therefore an appropriate method to use where fast establishment is needed. Smooth meadow-grass is the main species in almost all sod because the rhizomes are strong and bind the turf well together. This provides a robust commercial product that is easy to cut and install.

Smooth meadow-grass can be used in private lawns and parks where good winter hardiness is important and it should be used on sports grounds where the recuperative capacity and wear tolerance are of great importance.



Many varieties of smooth meadow-grasses are attacked by rust in damp coastal climates. Landvik, October 2011.

***Poa supina* SCHRAD.**

	Prostrate meadow-grass/ Creeping meadow-grass
	Supina bluegrass
	Trampgröe
	Lav rapgræs
	Veirapp
	Juurtonurmikka

Creeping meadow-grass is a perennial soft grass with stolons. The colour is typically light green, almost yellowish.

It thrives best in moist, fertile soil and shows aggressive growth and good wear tolerance. It establishes more quickly than smooth meadow-grass and starts to grow early in the spring. German studies have shown that this species out-competes other species in the shade even in areas with intense wear or short-mowing height such as tees and greens. There are not many varieties available on the market and experiences from Nordic variety testing are very limited.

***Poa trivialis* L.**

	Rough meadow-grass
	Rough bluegrass
	Kärrgröe
	Almindelig rapgræs
	Markrapp
	Karheanurmikka
	Hasveifgras

Rough meadow-grass has narrower leaves than smooth meadow-grass and normally grows in tufts, but it can also form short stolons. In nature, it grows in moist and shady areas and has a fairly light colour.

The bred varieties of rough-stalked meadow-grass are almost as dark as smooth meadow-grass and considerably darker than annual meadow-grass and creeping meadow-grass.

Rough meadow-grass has low wear tolerance and competes poorly with other species, but it may be useful

in a mixture with red fescue under trees or other areas with poor light conditions.

Rough meadow-grass tolerates low mowing and establishes significantly faster than smooth meadow-grass, almost as quickly as annual meadow-grass. Seed of rough meadow-grass can therefore be used for repair of golf greens, but the dense, fine-leaved varieties that are marketed for this purpose are bred for overseeding of greens in the southern states of the US and are not very durable under Nordic conditions. They are not adapted to our light conditions, and are easily outcompeted by other species.

Seeds of rough meadow-grass are of similar size to those of other meadow-grass species (3 000-5 000 seeds per gram).



The typical characteristics of the genus Poa - the leaves are broad all the way to the leaf tip, which is shaped like the bow of a boat.

GLOSSARY

ball mark: depression and/or tear in a short-cut grass surface, caused by the impact of a golf

ball roll: See 'stimpmeter'

colour (=genetic colour): darkness of green. Should be rated when the grass is growing and not affected by stress

disease resistance: ability to resist fungal diseases. There may be differences between diseases occurring during the growing season and diseases mainly attacking the turf at low temperatures under snow cover

divots: tufts of grass (and soil) displaced by the stroke of a golf club

dressings: the act of spreading sand or a sand-based soil mix on the top of a grass surface

drought tolerance: expression is used both about the grass' ability to maintain a nice and green appearance during drought, and about its ability to recover once the drought period is over

ecotype: plants within one species that have developed specific characteristics in adaptation to the environment. Ecotypes cannot always be distinguished morphologically

erosion: loss of soil due to wind or water flow

establishment rate: can be expressed as the number of days from planting grass seeds until the surface is ready for use. Strongly influenced by temperature and fertilizer level

fairway: short-cut grass surface between tee and green, from which the ball can easily be played

fertilizer requirement: plants with high growth rates have high fertilizer requirements. Appropriate fertilizer inputs are determined by targeted growth rate, length of growing season, soil reserves and other growing conditions

fungicide: chemical or biological compound used to control fungi that cause plant diseases

green: short-cut grass around the hole on a golf course

growth rate: a plant's ability to utilize nutrient availability and other growing conditions to produce biomass. This ability is genetically determined. See also 'fertilizer requirement'

horizontal growth (lateral growth): expression indicating the direction of growth for runners and sometimes grass leaves. See 'rhizome', 'stolon' and 'vertical growth'

leaf fineness (=leaf texture): width of grass leaves

mowing tolerance: character for grass tolerance to close mowing. Mowing height has a major impact on competition between grass species in a mixed sward

ornamental lawn: short-cut lawn with special aesthetic value. To be distinguished from recreational lawn

population: group of plants that belong to the same species and live in the same geographical area where they exchange genes and compete for resources

recuperative capacity: the capacity of a grass plant to repair voids in the surface, either through horizontal growth or by germination of seeds

rhizome: horizontal shoot (runner) below the soil surface. Can be distinguished from roots by having nodes with primordia for new shoots. See 'stolon'

runner: see 'rhizome' and 'stolon'

salt tolerance: ability to grow in soils with high concentration of salts

shade tolerance: ability to compete with other species under low light conditions. Grasses generally have high requirements to light compared with other plants

species: basic unit in plant taxonomy. Plant with the same species can interbreed and produce fertile seed

stimpmeter: instrument for measuring the resistance to ball roll on a golf green. A golf ball is rolled onto the green, and the distance from the starting point to the stopping point is measured. Ball roll is usually expressed in feet. Fast greens have high stimpmeter values (10 feet)

subspecies: unit used in plant taxonomy / botanical classification. Subordinate to 'species'. Group of plants within one species that have certain characteristics

stolon: horizontal shoot (runner) above the soil surface. See 'rhizome'

tee: area from which the golf ball is first played at each hole. The tee should be flat and have a short-cut grass cover

thatch: layer of dead and living organic material that develops between the grass sward and the soil surface

tiller density: the number of tillers per area unit. Tiller density usually increases with lower mowing height and increasing fertilizer levels

tufts: elevation in the grass surface caused by plants with high density /accumulation of tillers. Tufted grasses do not form rhizomes or stolons, but have intravaginal tiller development resulting in tufts

utility turf: low-maintenance grass-covered area that is not cut or cut only once or twice a year. Include road verges, set-a-side land, green roofs etc.

variety (cultivar): assemblage of plants belonging to one species or subspecies. A variety should have an approved name and a description based on morphological characters or a DNA-profile that distinguish it from other varieties. Varieties are owned and protected by plant breeders

vertical growth (growth in height): usually expressed as mm per day or accumulated height growth during a season

weed: plant growing in the wrong place. Includes mos-

ses and cultivated plants growing in the wrong place, e.g. white clover. Weeds are usually able to spread and compete with seeded plants

wear tolerance: ability to maintain surface quality during mechanical damage. Wear machines simulate the impact from the shoes of golf- or football players

winter colour: an expression for how green or faded (brown) the grass when it is not growing (outside the growing season). Winter colour can be influenced by autumn fertilisation

winter hardiness: ability to tolerate winter stress. There are many reasons for winter damage. Characters for winter hardiness summarize experiences over several years, whether damage is caused by low temperature, prolonged snow cover, desiccation, water, ice, or winter diseases



Seeding of test fields i Denmark, September 2011. Photo Anne Mette Dahl Jensen

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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 about STERF can be found at sterf.golf.se