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Evaluation of turfgrass varieties for use on Scandinavian putting greens, 2007-2010

Results from the sowing year 2007

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Summary:
This report gives the results of the sowing year 2007 from testing of turfgrass varieties for use on Scandinavian putting greens. The total project period is 2007-2010.

Sammendrag:
Dette er en rapport med resultater fra såingsåret 2007 fra prosjektet med testing av grassorter til bruk på skandinaviske golf greener. Hele prosjektperioden er 2007-2010.

County:	Norway / Østre Toten
Municipality:	Østre Toten
Place:	Kapp

Approved

Project leader

Arne Sæbø

Bjørn Molteberg

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1. Abstract

An evaluation of turfgrass varieties for use on Scandinavian putting greens started in 2007 as a new project for the period 2007-2010.

Four trials were established on putting greens constructed according to USGA standard at the locations Östra Ljungby Naturgymnasium, Sweden, Bioforsk Landvik and Bioforsk Apelsvoll, Norway and at a golf course in Keldnaholt, Iceland.

A total of 42 varieties within seven species and subspecies were entered into the project. The trials were established according to a split plot design with the species *Festuca rubra*, *Agrostis canina*, *Agrostis capillaris*, *Agrostis stolonifera*, *Poa trivialis* and *Lolium perenne* on main plots and varieties within species on subplots. Seeding dates for the different sites; Apelsvoll, Landvik, Keldnaholt and Östra Ljungby were June 26, July 11, August 17 and September 6, respectively.

Mowing three times a week to a minimum of 6 mm in *Festuca*, *Lolium* and *Poa* and 4 mm in *Agrostis* was carried at Apelsvoll and Landvik, but not at Keldnaholt and Östra Ljungby due to the late seeding and establishment. The trials at Apelsvoll and Landvik were rated at biweekly intervals for visual merit (overall turfgrass quality) and at monthly intervals for other characters. Only percent plant cover in October was registered at Keldnaholt and Östra Ljungby.

Several varieties especially of perennial ryegrass and rough-stalked meadow grass, but also of bentgrass and fescue showed promising results in the sowing year. The green years 2008, 2009 and 2010 will tell us more about these varieties.

2. Introduction

Plant breeding is a long-term and continuous process where new varieties are released every year. Therefore, evaluation of new turfgrass varieties for putting greens must also be a continuous process. Variety trials on USGA greens are expensive and the seed consumption small compared to other markets. The seed industry has signaled that variety testing for putting greens must, at least for the most part, be funded by the golf sector itself.

On this background, we thank The Scandinavian Turfgrass and Environment Research Foundation (STERF) for the financial grant, and a number of breeding- and seed companies for the interest and entrance fees, who have made it possible to start a new cultivar testing project on Scandinavian putting greens for the period 2007-2010.

The objectives for the project are:

- To clarify which varieties of *Agrostis*, *Festuca*, *Poa* and *Lolium* are best suited for putting greens at four experimental sites representing various climatic zones in the Nordic countries
- To create meeting places for discussions between plant breeders, seed companies and greenkeepers in order to encourage cultivar awareness and continued efforts into turfgrass breeding for northern environments

3. Methods

Plant material

A total of 42 varieties, including controls, were entered into the project. The distribution between species was as follows:

- Velvet bentgrass (*Agrostis canina*): 3 varieties
- Creeping bentgrass (*Agrostis stolonifera*): 10 varieties
- Colonial bentgrass (*Agrostis capillaris*): 5 varieties
- Slender creeping red fescue (*Festuca rubra* var. *trichophylla*): 6 varieties
- Chewings fescue (*Festuca rubra* var. *commutata*): 11 varieties
- Perennial ryegrass (*Lolium perenne*): 5 varieties
- Rough-stalked meadow grass (*Poa trivialis*): 2 varieties

Table 1 gives a complete list of varieties included in the project.

Table 1. List of varieties included into the green trials in Scandinavia 2007-2010.

Variety	Breeder / Representative	Variety	Breeder / Representative
<i>Festuca rubra</i> var. <i>commutata</i>		<i>Agrostis stolonifera</i>	
Center (C)	Innoseeds	Independence(C)	Innoseeds
Margret	DLF-Trifolium	Norlys (C)	Graminor
Greensleeves	DLF-Trifolium	IS AP 14	DLF-Trifolium
Frc 04210	Euro Grass	CY-2	DLF-Trifolium
Excellence	Euro Grass	Sandhill	Weibull Trädgård/Pickseed
LøRc 0215	Graminor	Bengal	Barenbrug
LøRc 0021 (Linda)	Graminor	Alpha	RAGT Genetique
SW RSC6101	Svalöf Weibull	Declaration	RAGT Genetique
SW RSC6028	Svalöf Weibull	L93	RAGT Genetique
Barswing	Barenbrug	MacKenzie	Scandinavian Seed/Pickseed
Musica	RAGT Genetique		
<i>Festuca rubra</i> var. <i>trichophylla</i>		<i>Agrostis capillaris</i>	
Cezanne (C)	Innoseeds	Jorvik (C)	DLF-Trifolium
Amarone	DLF-Trifolium	Leirin (C)	Graminor
Corrida	DLF-Trifolium	TAT 720	DLF-Trifolium
Niola	Euro Grass	LøEk 0015	Graminor
Frt 04213	Euro Grass	AberRoyal	Scandinavian Seed/BSH
Viktorka	Barenbrug		
<i>Poa trivialis</i>		<i>Agrostis canina</i>	
Qasar	Weibull Trädgård/Pickseed	Villa (C)	Innoseeds
Race horse	Scandinav. Seed/Pickseed	Legendary	DLF-Trifolium
		Vesper	Scandinavian Seed/Pickseed
<i>Lolium Perenne</i>			
INLP 634	DLF-Trifolium		
DP 17-2147	DLF-Trifolium		
Madrid	DLF-Trifolium		
DP 17-9974	DLF-Trifolium		
Ligala	Euro Grass		

C = Control variety (reference)

Experimental sites and climatic conditions

Trials were established at the experimental locations Östra Ljungby Naturgymnasium, Sweden, Bioforsk Landvik and Bioforsk Apelsvoll, Norway, and Keldnaholt Golf Course, Iceland. The following meteorological data indicate that these locations cover the variation in climates found in the Nordic countries:

	Northern latitude	Altitude	Mean monthly temperature June-August	Mean monthly temperature December-February	Annual precipitation
Östra Ljungby ¹	56° 11' N	38 m a.s.l	16.3 °C	0.3 °C	594 mm
Landvik	58° 20' N	6 m a.s.l	15.4 °C	-1,1 °C	1230 mm
Apelsvoll	61° 42' N	250 m a.s.l	14.0 °C	-7.2 °C	600 mm
Keldnaholt	64° 09' N	30 m a.s.l.	10.5 °C	-0.5 °C	950 mm

¹ Data for Alnarp

The four locations can roughly be said to represent the two main climatic zones in Scandinavia (Fig 1). Östra Ljungby and Landvik represent climatic zone 1, which includes Denmark, Skåne in Sweden and the coastal regions of southern Sweden and Norway. In addition, Östra Ljungby is a nice representative for golf courses in the densely populated regions of eastern Denmark and Skåne in Sweden. Apelsvoll and Keldnaholt represent climatic zone 2, which includes Iceland, Finland, central and northern parts of Sweden and Norway, plus continental areas in southern Sweden and Norway. Keldnaholt has a climate representative not only for Iceland, but also for the coastal areas in central and northern Norway. Apelsvoll can have snow cover for more than five months and sometimes ice cover for more than three months. This is in contrast to Landvik and Östra Ljungby, which usually have snow cover more sporadically during wintertime.

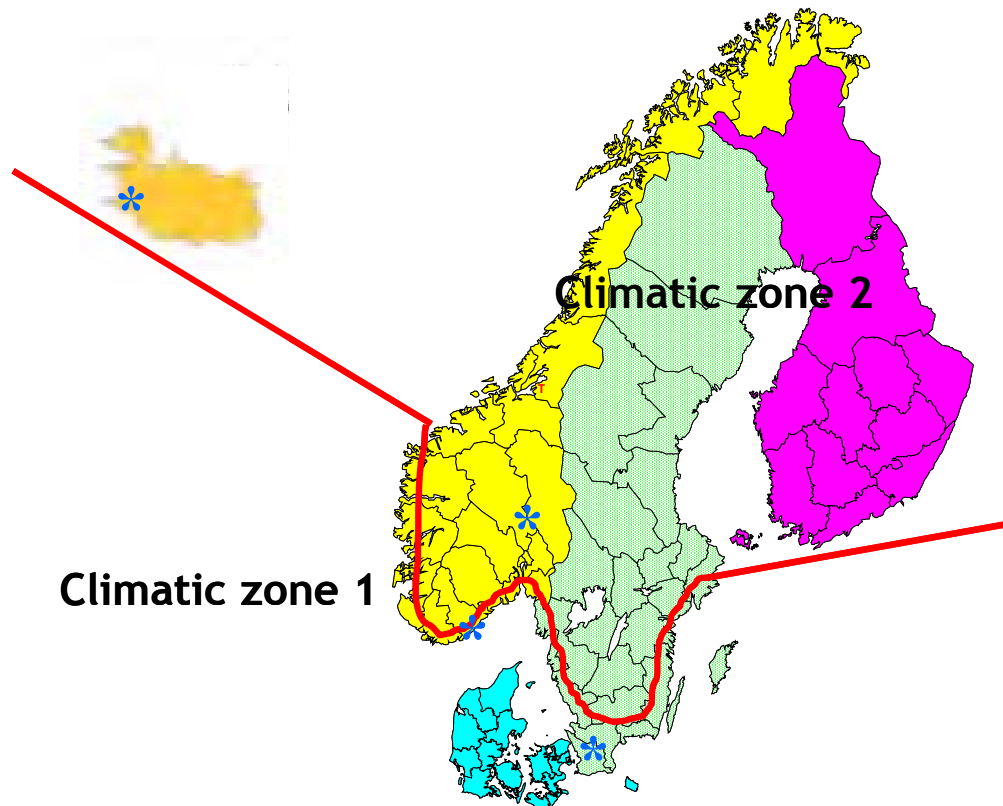


Fig. 1. Division of Scandinavia in two climate zones. The trial sites are marked with a blue star.

Green construction, experimental design and grow-in

The trials were established on putting greens constructed according to USGA standard with 30 cm rootzone layers of finely graded sand. Apelsvoll and Landvik already had such greens, which were deturfed to 4 cm and the topsoil replaced (Aamlid et al 2006). Östra Ljungby and Keldnaholt built new experimental greens the summer of 2007.

The trials at all locations were established according to a split plot design with three replicates (blocks), the species *Festuca rubra*, *Agrostis canina*, *Agrostis capillaris*, *Agrostis stolonifera*, *Poa trivialis* and *Lolium perenne* on main plots and varieties within species on subplots. This allows different managements of the various species. The seeding rates of *Agrostis*, *Poa*, *Festuca*, and *Lolium* were 0.5, 1.5, 3.0 and 4.0 kg per 100 m², respectively.

Seeding dates for the different sites were:

Apelsvoll: June 26
Landvik: July 11
Keldnaholt: August 17
Östra Ljungby: September 6

The trial at Keldnaholt was not seeded before August due to delayed construction of the green. For the trial at Östra Ljungby, seeding was delayed due to heavy rainfall in the summer months.

Plot size was 0.7m x 0.7m at Östra Ljungby and 1m x 1m at the other sites. During the first weeks after seeding, the trials were irrigated as required with 3-5 mm at least twice daily. The newly seeded trials at all sites were also protected with a white and fibrous (permeable) cover to avoid erosion and movement of the seed.

Mowing, fertilization and regular maintenance

At Apelsvoll and Landvik the first mowing was carried out with walk-behind mowers on July 14 and July 30, respectively. Mowing height was set to 9 mm. Over the next couple of months, the trials were mown three times a week with mowing height gradually being reduced to 6 mm in *Festuca*, *Lolium* and *Poa* and 4 mm in *Agrostis*. At the last mowings in late September, higher mowing heights were again practised. By reason of the late seeding and establishment, no mowing was carried out at Keldnaholt and Östra Ljungby.

At Apelsvoll and Landvik, 5 kg / 100 m² of the organic fertilizer Turf Food 14-3-5 was raked into the 5 cm topsoil before seeding the trials. After germination, these trials received inorganic fertilizer (Yara's 'Arena' program) at biweekly intervals. At Apelsvoll, ammonium sulphate was also included in the fertilizer programme in an attempt to lower pH and control take-all patch (*Gaeumannomyces graminis*). The fertilization in the grow-in year at both of Apelsvoll and Landvik were differentiated with a total of 1.3 kg N / 100 m² to *Festuca rubra*, *Lolium perenne*, *Agrostis canina* and *Agrostis capillaris* and 1.9 kg N / 100 m² to *Agrostis stolonifera* and *Poa trivialis*.

At Keldnaholt and Östra Ljungby, the total N-supplies were 0.5 and 0.78 kg N/100 m², respectively. No vertical cutting, aeration or simulated wear treatments were carried out in any of the experiments in the sowing year. Pesticides or growth regulators were also not used, and none of the plots were reseeded to compensate for poor establishment. The green at Landvik was top-dressed with 1 mm fine sand (0.2-0.7 mm) on 22 October.

Registrations, statistical calculations, and presentation of results

The trials at Apelsvoll and Landvik were rated at biweekly intervals for visual merit (overall turf grass quality) and at monthly intervals for most other characters. Due to the late seeding and establishment, only percent plant cover in October was registered at Keldnaholt and Östra Ljungby.

The characters presented in tables 2-9 in chapter 7 Appendix, were defined as follows:

- **Days to 50 % germination:** Number of days to 50 % field emergence.
- **Visual merit** = overall turf grass quality (1-9, 9 is best): Overall mean, summer and autumn values are means of all ratings during the months July - November, July - August and September - November, respectively.
- **Tiller density** (1-9, 9 is highest density): In the sowing year, this character was assessed only by the end of the growing season.
- **Plant cover:** % of plot area covered with healthy, undiseased turf of the sown species. Overall mean, summer and autumn values are means of all ratings during the periods July - November, July - August and September - November, respectively.
- **In-season disease** (% of plot area): Diseases mostly occurred during rainy periods in autumn. Major pathogens were *Pythium* sp. and *Microdochium nivale*. Overall mean, summer and autumn values are means of all ratings during the periods July - November, July - August and September - November, respectively.

The experimental data were analyzed using the Minitab 15 procedure Proc Anova, GLM. Analyses of variance were accomplished separately for each species and with replicates as the random variable. Whenever significant differences occurred, least significant differences (LSD) at the 5 % probability level values were calculated for direct comparisons between varieties. In a few cases, P-values between 5 % and 15 % were reported as 'tendencies'. In tables 2-9 species or varieties were ranked for visual merit mean scores. If two or more varieties had the same scores, they were further ranked for tiller density, and, if necessary, for plant cover.

4. Results and discussion

Comparison of species (Table 2)

On average for varieties, rough-stalked meadow grass and velvet bentgrass had the highest visual merit scores in the grow-in year. Velvet bentgrass had an outstanding tiller density, while rough-stalked meadow grass had about the same density as creeping bentgrass.

Perennial ryegrass had, as expected, the fastest germination. The creeping bentgrass and red fescue used the longest time to establish, together with rough-stalked meadow grass.

In autumn, and especially at Apelsvoll, more diseases (*Pythium* and *Microdochium nivale*) were observed in the different bentgrasses than in other species. In October-November around 20-50 % of each plot was infected. Colonial bentgrass tended to be more infected than velvet and creeping bentgrass.

Together with rough-stalked meadow grass, perennial ryegrass is a new species for golf greens in Scandinavia, and possible also in Europe? It will be interesting to follow this 'new' green-species over the next three green years.

Colonial bentgrass varieties (Table 3)

Among the colonial bentgrasses there were no significant differences in establishment, plant cover and visual merit. However, the Norwegian varieties 'Leirin' and 'LøEk 0015' seemed to be less dense than 'Jorvik', 'TAT 720' and 'AberRoyal'. On the other hand the Norwegian variety 'LøEk 0015' tended to be more resistant to diseases. 'Jorvik', which was very best colonial bentgrass variety in our previous project (Aamlid et al. 2006), had a very early and severe infection of *Pythium* at Landvik.

Velvet bentgrass varieties (Table 4)

The differences between overall means for the three varieties of velvet bentgrass were not significant at any location. At Apelsvoll 'Legendary' tended to become more infected by *Pythium* than 'Vesper' and 'Legendary'. On the other hand, 'Legendary' had the highest density at Landvik.

Creeping bentgrass varieties (Table 5)

Within creeping bentgrass, the reference variety 'Independence', which was one of the best in the last variety testing period 2003-2006 (Aamlid et al. 2006), and the new breeding line 'CY-2' had the highest visual merits. The Norwegian reference variety 'Nordlys', which was also ranked among the best in the last testing period, was now ranked in the middle. It was, however together with 'L93', less infected by *Pythium* than the other varieties. There were no significant differences between the varieties in establishment, density or percent plant cover.

Chewings fescue varieties (Table 6)

'Musica' and 'Barswing' were in 2007 ranked highest in visual merits, density and percent plant cover, followed closely by 'Frc 04210' and the reference 'Center' at most of the locations. At the bottom of table 6, significantly behind the other varieties for most parameters, we find 'LøRc 0021' (Linda). This variety was heavily contaminated with weeds in the seed and therefore had bad scores. There were no significant differences between varieties in days to 50 % germination and there were only traces of diseases in some varieties at Apelsvoll and Landvik.

Slender creeping fescue varieties (Table 7)

There were significant differences in visual merits and densities between the three varieties at the top of table 7 ('Amarone', 'Frt 04213' and 'Viktorka') and the three at the bottom ('Niola', 'Corrida' and 'Cezanne'). The reference 'Cezanne', which was one of the best ranked in the last testing period 2003-2006, had low scores for establishment, especially at Landvik. Also in this species there were only minor observations of diseases at Apelsvoll.

Lolium perenne varieties (Table 8)

In this species there seems to be many interesting varieties. The breeding line 'DP17-2147' was ranked on top with high scores for visual merit and density. No diseases were observed at any of the sites.

Rough-stalked meadow grass varieties (Table 9)

The most interesting variety so far is 'Qasar', which tended to be ranked higher than 'Race Horse'. No diseases were observed at any site.

5. Conclusions

Several varieties show promising results, especially within perennial ryegrass and rough-stalked meadow grass, but also within bentgrass and fescue.

The green years 2008, 2009 and 2010 will tell us more about the varieties.

6. References

Aamlid, T.S., B. Molteberg, F. Enger, A.A. Steensohn & Å. Susort & 2006. Evaluation of *Agrostis* and *Festuca* varieties for use on Scandinavian golf greens. Results from variety testing at Landvik and Apelsvoll 2003-2006. Bioforsk Report 1 (189), 32 pp.

7. Appendix (photos and tables)

Table 2: Comparison on species

Variety	Days to 50% germination	Visual merit (1-9)			Tiller density (1-9)	Plant cover %			In season diseases %		
		Overall mean	Summer	Autumn		Overall mean	Summer	Autumn	Overall mean	Summer	Autumn
A) Mean of four sites											
Poa trivialis	8	5,6	4,7	6,3	5,9	75	98	75	0	0	0
A. canina	6	5,4	4,8	5,7	6,8	73	94	73	8	1	12
A. stolonifera	8	4,8	3,8	5,5	6,0	68	90	69	10	0	15
F. rubra com.	8	4,6	4,1	5,1	5,3	74	94	74	0	0	1
A. capillaris	6	4,2	4,1	4,3	5,8	71	94	70	14	1	21
Lolium perenne	4	4,1	3,2	4,8	4,1	74	95	75	0	0	0
F. rubra trich.	9	3,7	3,0	4,3	5,0	69	85	72	0	0	0
P % varieties	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
LSD 5%	1	0,6	0,6	0,6	0,4	4	6	4	5	1	8
P % species x sites	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Number of sites	2	2	2	2	2	4	2	4	2	2	2
B) Apelsvoll											
A. canina	6	5,7	5,7	5,8	6,8	93	95	92	14	2	20
A. stolonifera	6	5,6	5,1	6,1	6,3	93	94	91	18	0	27
Poa trivialis	7	4,9	4,2	5,7	6,0	97	96	98	0	0	0
A. capillaris	6	4,6	4,6	4,6	5,9	90	94	87	23	2	34
F. rubra com.	6	4,3	3,7	4,9	5,2	94	92	96	1	0	1
F. rubra trich.	7	3,9	3,2	4,7	4,9	92	88	96	0	0	1
Lolium perenne	4	3,4	2,5	4,3	4,1	97	97	97	0	0	0
P % varieties	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
LSD 5%	1	0,7	0,7	0,8	0,5	4	6	5	10	1	15
C) Keldnaholt											
Poa trivialis						93		93			
A. canina						90		90			
F. rubra com.						89		89			
Lolium perenne						88		88			
F. rubra trich.						86		86			
A. capillaris						85		85			
A. stolonifera						78		78			
P % varieties						0,0		0,0			
LSD 5%						12		12			

Table 2 continued: Comparison on species

Variety	Days	Visual merit (1-9)			Tiller	Plant cover %			In season diseases %		
	to 50% germination	Overall mean	Summer	Autumn	density (1-9)	Overall mean	Summer	Autumn	Overall mean	Summer	Autumn
D) Landvik											
Poa trivialis	9	6,3	5,2	6,9	5,9	100	99	100	0	0	0
A. canina	6	5,1	3,9	5,7	6,8	95	93	98	2	0	3
F. rubra com.	9	5,0	4,5	5,2	5,4	98	97	99	0	0	0
Lolium perenne	5	4,8	4,0	5,2	4,0	96	93	99	0	0	0
A. stolonifera	9	4,0	2,5	4,8	5,7	92	86	97	1	0	2
A. capillaris	6	3,8	3,6	3,9	5,7	94	94	93	4	1	7
F. rubra trich.	10	3,6	2,9	3,9	5,1	89	82	96	0	0	0
P % varieties	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
LSD 5%	2	0,9	0,9	1,0	0,6	7	11	4	2	1	3
E) Östra Ljungby											
Lolium perenne						16		16			
A. capillaris						13		13			
F. rubra com.						13		13			
A. canina						12		12			
F. rubra trich.						10		10			
A. stolonifera						10		10			
Poa trivialis						11		11			
P % varieties						1,1		1,1			
LSD 5%						8		8			

Table 3: Varieties of colonial bentgrass (*Agrostis capillaris*)

Variety	Days	Visual merit (1-9)			Tiller	Plant cover %			In season diseases %		
	to 50% germination	Overall mean	Summer	Autumn	density (1-9)	Overall mean	Summer	Autumn	Overall mean	Summer	Autumn
A) Mean of four sites											
TAT 720	7	4,4	4,3	4,4	5,8	70	96	68	19	1	29
AberRoyal	6	4,3	4,0	4,4	6,0	71	94	70	16	1	25
Jorvik (C)	6	4,2	4,4	4,1	6,1	70	93	69	12	3	18
Leirin (C)	6	4,2	3,9	4,3	5,6	71	93	70	13	1	20
LøEk 0015	6	4,0	3,8	4,1	5,5	72	94	71	8	0	13
P % varieties	ns	ns	0,8	ns	0,6	ns	ns	ns(10)	0,0	ns(5,8)	0,0
LSD 5%			0,3		0,4				4		6
P % varieties x sites	ns	ns(5,3)	0,9	ns(6,6)	ns	4,9	ns(5,1)	2,4	0,0	ns	0,0
Number of sites	2	2	2	2	2	4	2	4	2	2	2
B) Apelsvoll											
Jorvik (C)	6	5,0	5,0	5,0	6,2	93	95	91	15	2	22
Leirin (C)	6	4,7	4,8	4,6	5,8	91	94	88	24	2	35
TAT 720	6	4,6	4,8	4,4	5,8	88	94	82	33	2	48
AberRoyal	6	4,5	4,6	4,5	6,2	90	95	85	29	1	43
LøEk 0015	6	4,2	4,0	4,4	5,7	90	92	89	15	1	23
P %	ns	ns(5,8)	2,5	ns	ns	ns (11)	4,8	ns (8)	0,2	ns	0,1
LSD 5%			0,6				2		7		11
C) Keldnaholt											
LøEk 0015						88		88			
Leirin (C)						87		87			
TAT 720						85		85			
AberRoyal						83		83			
Jorvik (C)						82		82			
P %						ns		ns			
LSD 5%											
D) Landvik											
TAT 720	7	4,1	3,8	4,3	5,7	94	97	92	5	0	9
AberRoyal	7	4,0	3,5	4,3	5,9	94	94	94	3	0	7
LøEk 0015	6	3,8	3,7	3,8	5,3	97	97	97	1	0	3
Leirin (C)	6	3,7	3,1	4,0	5,4	93	91	94	2	0	4
Jorvik (C)	6	3,4	3,8	3,2	6,1	91	92	89	9	4	14
P %	ns	ns	2,9	ns	0	ns	ns	ns(12)	3,9	ns	2,7
LSD 5%			0,4		0,2				5		7
E) Östra Ljungby											
AberRoyal						17		17			
Jorvik (C)						13		13			
TAT 720						13		13			
Leirin (C)						12		12			
LøEk 0015						12		12			
P %						ns		ns			
LSD 5%											

Table 4: Varieties of velvet bentgrass (*Agrostis canina*)

Variety	Days	Visual merit (1-9)			Tiller	Plant cover %			In season diseases %		
	to 50% germination	Overall mean	Summer	Autumn	density (1-9)	Overall mean	Summer	Autumn	Overall mean	Summer	Autumn
A) Mean of four sites											
Vesper	6	5,5	4,9	5,8	6,8	73	96	73	7	2	10
Legendary	6	5,4	4,9	5,6	6,9	72	94	72	10	1	14
Villa (C)	6	5,4	4,6	5,9	6,6	72	92	73	7	1	10
P % varieties	ns	ns	ns	ns	ns	ns (8)	ns	ns (9)	ns (12)	2	ns
LSD 5%										1	
P % varieties x sites	ns	ns	ns	ns	ns	ns	ns	ns (7)	3,3	3,9	3,3
Number of sites	2	2	2	2	2	4	2	4	2	2	2
B) Apelsvoll											
Vesper	6	5,8	5,8	5,8	7,0	94	95	93	11	3	16
Villa (C)	6	5,8	5,6	6,1	6,5	94	95	93	13	1	18
Legendary	6	5,6	5,8	5,4	6,8	92	95	89	19	2	27
P %	ns	ns	ns	ns	ns	ns	ns	ns	ns (9)	4,9	ns (9)
LSD 5%										1	
C) Keldnaholt											
Legendary						90		90			
Vesper						90		90			
Villa (C)						90		90			
P %						ns		ns			
LSD 5%											
D) Landvik											
Vesper	6	5,3	4,1	5,8	6,6	97	96	97	3	0	5
Legendary	6	5,2	4,0	5,7	6,9	96	93	98	1	0	2
Villa (C)	6	5,0	3,7	5,6	6,7	94	89	98	1	0	2
P %	ns	ns	ns	ns	0,8	ns	ns	ns	ns	ns	ns
LSD 5%					0,1						
E) Östra Ljungby											
Vesper						13		13			
Legendary						10		10			
Villa (C)						12		12			
P %						ns		ns			
LSD 5%											

Table 5: Varieties of creeping bentgrass (*Agrostis stolonifera*)

Variety	Days	Visual merit (1-9)			Tiller	Plant cover %			In season diseases %		
	to 50% germination	Overall mean	Summer	Autumn	density (1-9)	Overall mean	Summer	Autumn	Overall mean	Summer	Autumn
A) Mean of four sites											
CY-2	9	5,3	4,0	6,1	6,0	66	91	67	8	0	13
Independence (C)	7	5,1	4,0	5,8	6,1	69	94	69	15	0	22
MacKenzie	8	4,9	4,0	5,4	6,1	68	92	68	11	0	16
L93	8	4,8	3,8	5,5	6,0	71	92	73	3	0	5
Nordlys (C)	7	4,8	3,9	5,4	5,8	65	91	66	6	0	9
Bengal	7	4,8	3,8	5,3	6,0	69	89	70	14	0	21
Sandhill	8	4,7	3,8	5,3	6,0	68	87	70	7	0	11
IS AP 14	7	4,7	3,6	5,4	6,1	69	93	69	12	0	19
Alpha	7	4,6	3,6	5,3	5,7	68	90	69	11	0	17
Declaration	9	4,5	3,3	5,4	5,9	66	84	69	8	0	12
P % varieties	ns (10)	ns (12)	2,2	ns	ns	ns	ns	ns	ns(5,3)	ns	4,7
LSD 5%			0,4								11
P % varieties x sites	ns (10)	ns	ns	ns	ns	ns	ns	ns	ns (10)	ns	ns (12)
Number of sites	2	2	2	2	2	4	2	4	2	2	2
B) Apelsvoll											
CY-2	6	6,0	5,5	6,6	6,3	93	94	92	16	0	23
L93	6	5,8	5,2	6,5	6,5	96	95	96	7	0	10
Sandhill	6	5,7	5,3	6,1	6,5	93	95	92	13	0	20
Independence (C)	6	5,7	5,2	6,2	6,3	92	96	88	27	0	41
Bengal	6	5,6	5,3	5,9	6,3	91	94	88	27	0	40
MacKenzie	6	5,6	5,3	5,8	6,2	93	96	90	20	0	30
Nordlys (C)	6	5,6	5,1	6,1	6,0	93	94	92	11	0	16
Alpha	6	5,5	4,9	6,0	6,0	92	95	88	22	0	33
IS AP 14	6	5,4	4,9	5,8	6,3	92	95	89	23	0	35
Declaration	6	5,3	4,5	6,1	6,3	91	88	94	14	0	22
P %	ns	ns	ns	ns	ns	ns	ns	ns	ns (10)	ns	ns (10)
LSD 5%											
C) Keldnaholt											
Bengal						83		83			
L93						83		83			
Alpha						82		82			
Independence (C)						82		82			
Sandhill						82		82			
IS AP 14						78		78			
MacKenzie						77		77			
Declaration						75		75			
Nordlys (C)						70		70			
CY-2						68		68			
P %						ns		ns			
LSD 5%											

Table 5 continued: Varieties of creeping bentgrass (*Agrostis stolonifera*)

Variety	Days	Visual merit (1-9)			Tiller	Plant cover %			In season diseases %		
	to 50% germination	Overall mean	Summer	Autumn	density (1-9)	Overall mean	Summer	Autumn	Overall mean	Summer	Autumn
D) Landvik											
CY-2	12	4,6	2,6	5,6	5,7	93	87	98	1	0	2
Independence (C)	8	4,5	2,9	5,3	5,8	94	92	96	2	0	4
MacKenzie	10	4,1	2,6	4,9	6,0	93	89	97	1	0	3
Nordlys (C)	8	4,1	2,8	4,8	5,6	92	88	96	1	0	2
IS AP 14	8	4,0	2,3	4,9	5,9	94	91	97	2	0	3
Bengal	8	3,9	2,4	4,7	5,7	91	84	98	1	0	2
L93	10	3,9	2,4	4,6	5,5	93	89	98	0	0	0
Sandhill	10	3,8	2,4	4,5	5,5	89	80	98	1	0	2
Declaration	12	3,8	2,0	4,7	5,6	88	81	96	1	0	3
Alpha	8	3,8	2,3	4,5	5,3	90	84	97	1	0	2
P %	ns (13)	ns	ns	ns	ns	ns	ns	ns	ns (8)	ns	ns (9)
LSD 5%											
E) Östra Ljungby											
L93						13		13			
Declaration						12		12			
Bengal						10		10			
Independence (C)						10		10			
IS AP 14						10		10			
MacKenzie						10		10			
Sandhill						10		10			
Alpha						8		8			
CY-2						8		8			
Nordlys (C)						7		7			
P %						ns		ns			
LSD 5%											

Table 6: Varieties of chewings fescue (*Festuca rubra* var. *commutata*)

Variety	Days	Visual merit (1-9)			Tiller	Plant cover %			In season diseases %		
	to 50% germination	Overall mean	Summer	Autumn	density (1-9)	Overall mean	Summer	Autumn	Overall mean	Summer	Autumn
A) Mean of four sites											
Musica	8	5,3	4,6	5,8	5,8	76	96	77	0	0	1
Barswing	8	5,2	4,5	5,8	5,6	75	96	76	1	0	1
Center (C)	8	4,9	4,3	5,4	5,4	73	95	73	0	0	1
Frc 04210	8	4,9	4,4	5,4	5,4	73	96	74	0	0	1
Margret	8	4,7	4,0	5,2	5,4	74	94	75	0	0	1
Greensleeves	9	4,7	3,9	5,3	5,5	70	89	72	0	0	0
SW RSC6028	8	4,5	4,1	4,9	5,2	75	95	76	0	0	0
LøRc 0215	8	4,5	4,2	4,8	5,3	74	96	75	0	0	0
Excellence	8	4,3	3,7	4,7	5,1	73	92	74	0	0	0
SW RSC6101	8	4,2	3,9	4,5	5,1	73	94	74	0	0	0
LøRc 0021 (Linda)	8	3,8	3,7	4,0	4,7	72	94	72	0	0	0
P % varieties	0,0	0,0	0,8	0,0	0,0	0,7	0,0	2,4	2,4	ns	2,5
LSD 5%	0	0,4	0,5	0,4	0,2	3	3	3	0		1
P % varieties x sites	ns	ns	ns	ns	0,7	ns	3,1	3,6	4,1	ns	4,9
Number of sites	2	2	2	2	2	4	2	4	2	2	2
B) Apelsvoll											
Barswing	6	5,1	4,4	5,8	5,5	96	94	99	2	0	3
Musica	6	5,0	4,4	5,7	5,5	97	95	99	1	0	1
Frc 04210	6	4,6	3,8	5,3	5,0	95	93	97	0	0	1
Center (C)	6	4,5	3,8	5,1	5,3	94	92	97	1	0	1
Margret	6	4,3	3,6	5,1	5,2	95	92	98	1	0	1
Greensleeves	7	4,3	3,6	4,9	5,5	90	83	97	0	0	1
Excellence	6	4,2	3,6	4,8	5,2	94	91	97	1	0	1
SW RSC6028	6	4,2	3,6	4,8	5,0	95	93	97	1	0	1
LøRc 0215	6	4,0	3,3	4,7	5,2	95	94	96	0	0	1
SW RSC6101	6	4,0	3,5	4,5	5,0	94	92	96	0	0	1
LøRc 0021 (Linda)	7	3,4	3,2	3,6	4,5	89	90	88	0	0	0
P %	0,4	0,0	0,2	0,0	0,0	0,0	0,5	0,0	4,8	ns	4,8
LSD 5%	1	0,5	0,5	0,7	1,0	2	5	1	1		1
C) Keldnaholt											
Musica						93		93			
Margret						92		92			
SW RSC6028						92		92			
SW RSC6101						92		92			
Barswing						90		90			
Frc 04210						90		90			
LøRc 0215						90		90			
Center (C)						88		88			
Excellence						88		88			
LøRc 0021 (Linda)						87		87			
Greensleeves						78		78			
P %						ns (8)		ns (8)			
LSD 5%											

Table 6 continued: Varieties of chewings fescue (*Festuca rubra* var. *commutata*)

Variety	Days	Visual merit (1-9)			Tiller	Plant cover %			In season diseases %		
	to 50% germination	Overall mean	Summer	Autumn	density (1-9)	Overall mean	Summer	Autumn	Overall mean	Summer	Autumn
D) Landvik											
Musica	9	5,6	4,8	5,9	6,1	98	97	100	0	0	0
Center (C)	10	5,4	4,8	5,8	5,4	99	99	100	0	0	0
Barswing	9	5,4	4,7	5,8	5,7	99	98	99	0	0	0
Frc 04210	9	5,2	4,9	5,4	5,7	99	98	99	0	0	0
Greensleeves	10	5,1	4,2	5,6	5,6	98	96	100	0	0	0
Margret	9	5,1	4,5	5,3	5,6	97	96	99	0	0	1
LøRc 0215	9	5,0	5,0	5,0	5,4	99	98	100	0	0	0
SW RSC6028	9	4,9	4,6	5,0	5,3	99	98	99	0	0	0
SW RSC6101	9	4,5	4,3	4,6	5,2	98	97	99	0	0	0
Excellence	10	4,3	3,8	4,6	5,1	96	93	98	0	0	0
LøRc 0021 (Linda)	9	4,3	4,3	4,3	4,8	98	98	99	0	0	0
P %	ns	1,4	ns	0,0	0,0	ns (5,8)	ns(7,4)	3,5	ns	ns	ns
LSD 5%		0,7		0,7	0,2			1			
E) Östra Ljungby											
Musica						17		17			
Barswing						15		15			
LøRc 0021 (Linda)						15		15			
SW RSC6028						15		15			
Excellence						13		13			
Greensleeves						13		13			
LøRc 0215						13		13			
Margret						13		13			
Frc 04210						10		10			
SW RSC6101						10		10			
Center (C)						8		8			
P %						ns		ns			
LSD 5%											

Table 7: Varieties of slender creeping fescue (*Festuca rubra* var. *trichophylla*)

Variety	Days	Visual merit (1-9)			Tiller	Plant cover %			In season diseases %		
	to 50% germination	Overall mean	Summer	Autumn	density (1-9)	Overall mean	Summer	Autumn	Overall mean	Summer	Autumn
A) Mean of four sites											
Amarone	8	4,4	3,7	4,9	5,2	72	92	73	0	0	0
Frø 04213	8	4,1	3,3	4,7	5,4	72	89	74	0	0	0
Viktorka	8	4,1	3,3	4,6	5,3	72	88	74	0	0	0
Niola	8	3,3	2,7	3,8	4,9	69	86	71	0	0	0
Corrida	8	3,3	2,7	3,8	4,8	69	86	71	0	0	0
Cezanne (C)	10	3,3	2,6	3,8	4,7	63	71	69	0	0	0
P % varieties	0,0	0,1	0,1	0,1	0,0	0,0	0,0	0,6	ns	ns	ns
LSD 5%	1	0,5	0,5	0,6	0,3	3	6	3			
P % varieties x sites	2,1	2,8	1,2	ns (10)	0,2	ns	ns	ns	ns	ns	ns
Number of sites	2	2	2	2	2	4	2	4	2	2	2
B) Apelsvoll											
Viktorka	7	4,3	3,5	5,1	5,0	94	91	98	0	0	1
Frø 04213	6	4,2	3,3	5,0	5,0	94	92	97	0	0	1
Amarone	6	4,0	3,2	4,8	4,8	93	90	96	0	0	0
Cezanne (C)	8	3,8	3,2	4,5	4,7	86	76	96	0	0	1
Niola	6	3,6	3,0	4,3	5,0	93	91	96	0	0	1
Corrida	6	3,6	2,8	4,3	5,0	93	91	96	0	0	1
P %	0,6	ns(5,2)	ns (16)	4,9	ns (12)	3,6	1,1	ns	ns	ns	ns
LSD 5%	1			0,6		5	8				
C) Keldnaholt											
Frø 04213						90		90			
Viktorka						90		90			
Amarone						85		85			
Niola						85		85			
Cezanne (C)						83		83			
Corrida						83		83			
P %						ns (7)		ns (7)			
LSD 5%											
D) Landvik											
Amarone	9	4,8	4,2	5,1	5,6	97	94	100	0	0	0
Frø 04213	10	4,0	3,2	4,5	5,7	92	86	99	0	0	0
Viktorka	10	3,8	3,2	4,2	5,5	92	85	99	0	0	0
Corrida	10	3,0	2,5	3,3	4,6	88	81	95	0	0	0
Niola	10	3,0	2,4	3,3	4,8	86	80	91	0	0	0
Cezanne (C)	13	2,8	2,0	3,1	4,7	78	66	91	0	0	0
P %	0,0	0,9	0,8	1,7	0,3	1,2	0,4	ns	ns	ns	ns
LSD 5%	1	1,0	1,0	1,1	0,6	9	11				

Table 7 continued: Varieties of slender creeping fescue (*Festuca rubra* var. *trichophylla*)

Variety	Days	Visual merit (1-9)			Tiller	Plant cover %			In season diseases %		
	to 50% germination	Overall mean	Summer	Autumn	density (1-9)	Overall mean	Summer	Autumn	Overall mean	Summer	Autumn
E) Östra Ljungby											
Amarone						13		13			
Niola						12		12			
Viktorka						12		12			
Corrida						10		10			
Frt 04213						10		10			
Cezanne (C)						5		5			
P %						ns		ns			
LSD 5%											

Table 8: Varieties of perennial ryegrass (*Lolium perenne*)

Variety	Days	Visual merit (1-9)			Tiller	Plant cover %			In season diseases %		
	to 50% germination	Overall mean	Summer	Autumn	density (1-9)	Overall mean	Summer	Autumn	Overall mean	Summer	Autumn
A) Mean of four sites											
DP 17-2147	5	4,5	3,6	5,3	4,5	75	96	76	0	0	0
Madrid	4	4,2	3,5	4,7	4,1	73	95	74	0	0	0
Ligala	4	4,0	3,2	4,7	4,0	76	96	77	0	0	0
DP 17-9974	4	4,0	3,1	4,6	3,9	74	94	75	0	0	0
INLP 634	5	3,8	2,9	4,5	3,8	73	93	74	0	0	0
P % varieties	ns	1,7	4,1	2,2	0,1	ns	ns	ns	ns	ns	ns
LSD 5%		0,4	0,5	0,5	0,3						
P % varieties x sites	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
Number of sites	2	2	2	2	2	4	2	4	2	2	2
B) Apelsvoll											
DP 17-2147	4	4,0	3,0	4,9	4,7	98	98	98	0	0	0
Madrid	4	3,6	2,8	4,3	4,0	97	98	97	0	0	0
DP 17-9974	4	3,3	2,3	4,3	4,0	98	98	98	0	0	0
Ligala	4	3,2	2,2	4,3	4,0	97	96	97	0	0	0
INLP 634	4	3,0	2,0	3,9	4,0	97	96	97	0	0	0
P %	ns	1,6	3,2	2,7	4,5	ns (10)	ns	ns	ns	ns	ns
LSD 5%		0,5	0,6	0,5	0,5						
C) Keldnaholt											
Ligala						92		92			
DP 17-9974						90		90			
INLP 634						87		87			
Madrid						87		87			
DP 17-2147						85		85			
P %						ns		ns			
LSD 5%											
D) Landvik											
DP 17-2147	5	5,1	4,2	5,6	4,4	97	95	100	0	0	0
Ligala	5	4,9	4,3	5,2	3,9	98	97	99	0	0	0
Madrid	5	4,8	4,1	5,1	4,2	96	93	100	0	0	0
DP 17-9974	5	4,6	3,8	5,0	3,9	94	89	99	0	0	0
INLP 634	5	4,6	3,8	5,0	3,6	95	90	99	0	0	0
P %	ns	ns	ns	ns	2,3	ns	ns	ns	ns	ns	ns
LSD 5%					0,4						
E) Östra Ljungby											
DP 17-2147						20		20			
Ligala						18		18			
DP 17-9974						13		13			
INLP 634						13		13			
Madrid						13		13			
P %						ns		ns			
LSD 5%											

Table 9: Varieties of rough-stalked meadow grass (*Poa trivialis*)

Variety	Days to 50% germination	Visual merit (1-9)			Tiller density (1-9)	Plant cover %			In season diseases %		
		Overall mean	Summer	Autumn		Overall mean	Summer	Autumn	Overall mean	Summer	Autumn
A) Mean of four sites											
Qasar	8	5,7	4,8	6,4	6,0	75	97	75	0	0	0
Race horse	8	5,5	4,5	6,1	5,9	75	98	76	0	0	0
P % varieties	ns	ns (9)	ns	2,2	ns	ns	ns	ns	ns	ns	ns
LSD 5%				0,2							
P % varieties x sites	ns	ns	ns	ns	ns	ns (9)	ns	ns (8)	ns	ns	ns
Number of sites	2	2	2	2	2	4	2	4	2	2	2
B) Apelsvoll											
Qasar	7	5,0	4,3	5,8	6,0	97	96	98	0	0	0
Race horse	7	4,8	4,1	5,5	6,0	97	96	97	0	0	0
P %	ns	ns(7,4)	ns	ns(5.7)	ns	ns	ns	ns	ns	ns	ns
LSD 5%											
C) Keldnaholt											
Qasar						93		93			
Race horse						92		92			
P %						ns		ns			
LSD 5%											
D) Landvik											
Qasar	9	6,4	5,3	7,0	6,0	100	99	100	0	0	0
Race horse	9	6,2	5,0	6,8	5,8	99	99	100	0	0	0
P %	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
LSD 5%											
E) Östra Ljungby											
Race horse						13		13			
Qasar						8		8			
P %						ns		ns			
LSD 5%											



Photo 1. The variety green at Apelsvoll, October 2007. (Photo: Bjørn Molteberg)



Photo 2. The variety green at Landvik, July 2007. (Photo: Trygve S. Aamlid)



Photo 3. The variety green at Keldnaholt, September 2007. (Photo: Gudni Thorvaldsson)



Photo 4. The variety green at Östra Ljungby, October 2007. (Photo: Daniel Nord)