LOW INPUT TURFGRASS SPECIES – STRONG AND WEAK CHARACTERISTICS

TRYGVE S. AAMLID

NIBIO TURFGRASS RESEARCH GROUP

NIBIO
NORWEGIAN INSTITUTE OF BIOECONOMY RESEARCH

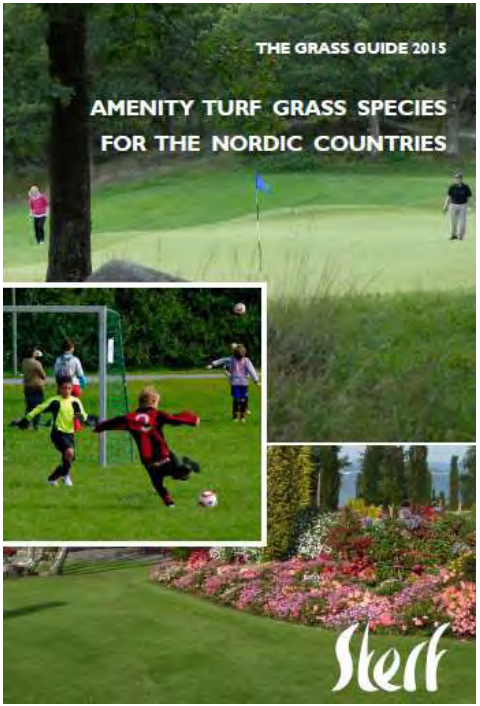
Sterf

Low input of what ?

- *Pesticides (incl. growth regulators)*
- *Water*
- *Nutrients*
- *Mowing*
- *Mechanical treatments: Verticutting, aeration, rolling etc.*
- *Seed and labor for reestablishment*

(Fossile) Energy

STERF's newly revised Guide to Turfgrass Species (2015)



The Grass Guide's ranking of 16 species/subspecies for 13 various characters (1-9)

Species	Establishment rate	Tiller density	Leaf fineness	Winter hardiness	Winter color	Fertilizer requirement	Hoizontal growth	Wear tolerance	Toleance to in-season diseases	Toleramnce to low mowing	Shade tolerance	Drought tolewrance	Salt tolerance
Agrostis canina	7	9	7	7	8	4	3	5	4	8	6	7	4
A. capilliaris	6	6*	5*	6*	4	5	5	3	3	7	6	3	2
A. stolonifera	6	8	5	6	4	7	8	5	5	8	4	3	5
Desc. cespitosa	3	5	4	8	4	6	1	5	9	3	8	3	4
Festuca ovina	2	6	8	5*	4	2	1	1	7	4	6	8	5
Festuca rubra													
ssp. commutata	4	6	7	7	4	4	1	4	8	5	7	6	6
ssp. litoralis	4	6	7	5	6	4	3	5	7	5	7	7	7
-ssp. rubra	4	4	6	5*	5*	4	5	3	6	4	7	8	6
F. trachyphylla	3	6	7	5	4	2	1	1	7	4	6	9	5
Lolium perenne	8	4	5	3	7	8	2	8	7	4	5	6	8
L. multiforum	9	3	4	1	8	8	2	8	7	3	5	5	8
Poa annua	8	5	5	2	5	8	3	4	2	7	6	1	2
Poa pratensis	2	3	3	8	4	7	8	7	6	2	3	4	3
Poa supina	5	5	5	6	4	7	8	7	6	5	7	4	3
Poa trivialis	7	6	7	3	8	6	5	3	5	7	8	3	3

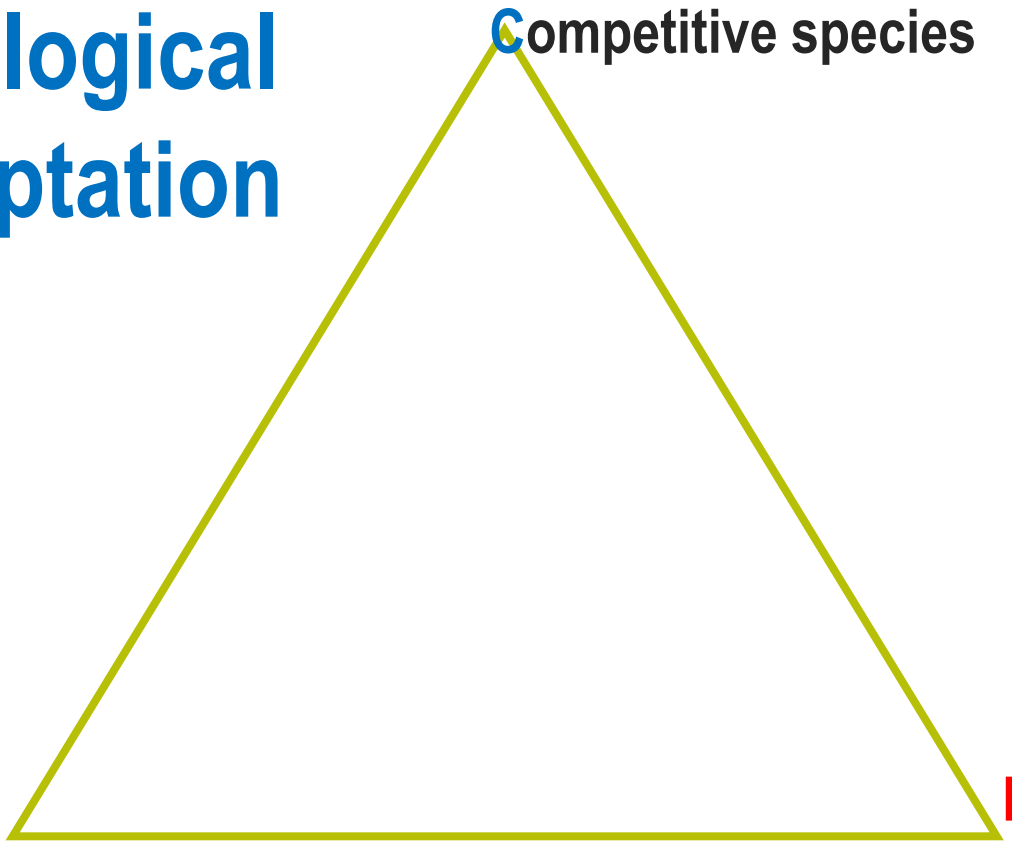
Low input characteristics

Species	Establishment rate	Tiller density	Leaf fineness	Winter hardiness	Winter color	Fertilizer requirement	Hoizontal growth	Wear tolerance	Toleance to in-season diseases	Toleramnce to low mowing	Shade tolerance	Drought tolerance	Salt tolerance
Agrostis canina	7	9	7	7	8	4	3	5	4	8	6	7	4
A. capilliaris	6	6*	5*	6*	4	5	5	3	3	7	6	3	2
A. stolonifera	6	8	5	6	4	7	8	5	5	8	4	3	5
Desc. cespitosa	3	5	4	8	4	6	1	5	9	3	8	3	4
Festuca ovina	2	6	8	5*	4	2	1	1	7	4	6	8	5
Festuca rubra													
ssp. commutata	4	6	7	7	4	4	1	4	8	5	7	6	6
ssp. litoralis	4	6	7	5	6	4	3	5	7	5	7	7	7
-ssp. rubra	4	4	6	5*	5*	4	5	3	6	4	7	8	6
F. trachyphylla	3	6	7	5	4	2	1	1	7	4	6	9	5
Lolium perenne	8	4	5	3	7	8	2	8	7	4	5	6	8
L. multiforum	9	3	4	1	8	8	2	8	7	3	5	5	8
Poa annua	8	5	5	2	5	8	3	4	2	7	6	1	2
Poa pratensis	2	3	3	8	4	7	8	7	6	2	3	4	3
Poa supina	5	5	5	6	4	7	8	7	6	5	7	4	3
Poa trivialis	7	6	7	3	8	6	5	3	5	7	8	3	3

Which grasses are ‘low input’ ?

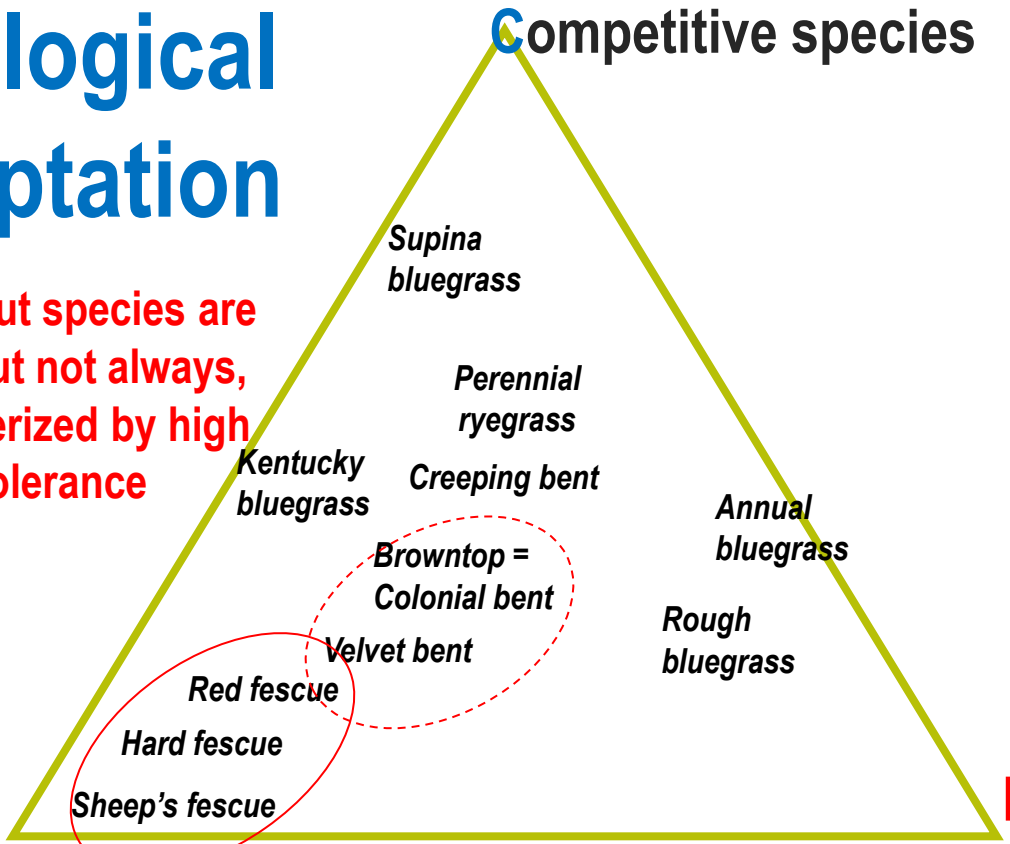
Species	Establishment rate	Tiller density	Leaf fineness	Winter hardiness	Winter color	Fertilizer requirement	Hoizontal growth	Wear tolerance	Toleance to in-season diseases	Toleramnce to low mowing	Shade tolerance	Drought tolewrance	Salt tolerance
Agrostis canina	7	9	7	7	8	4	3	5	4	8	6	7	4
A. capilliaris	6	6*	5*	6*	4	5	5	3	3	7	6	3	2
A. stolonifera	6	8	5	6	4	7	8	5	5	8	4	3	5
Desc. cespitosa	3	5	4	8	4	6	1	5	9	3	8	3	4
Festuca ovina	2	6	8	5*	4	2	1	1	7	4	6	8	5
Festuca rubra													
ssp. commutata	4	6	7	7	4	4	1	4	8	5	7	6	6
ssp. litoralis	4	6	7	5	6	4	3	5	7	5	7	7	7
-ssp. rubra	4	4	6	5*	5*	4	5	3	6	4	7	8	6
F. trachyphylla	3	6	7	5	4	2	1	1	7	4	6	9	5
Lolium perenne	8	4	5	3	7	8	2	8	7	4	5	6	8
L. multiforum	9	3	4	1	8	8	2	8	7	3	5	5	8
Poa annua	8	5	5	2	5	8	3	4	2	7	6	1	2
Poa pratensis	2	3	3	8	4	7	8	7	6	2	3	4	3
Poa supina	5	5	5	6	4	7	8	7	6	5	7	4	3
Poa trivialis	7	6	7	3	8	6	5	3	5	7	8	3	3

Ecological adaptation



Ecological adaptation

Low input species are often, but not always, characterized by high stress tolerance



Low input species for greens

SCANGREEN variety trials: In the two last test rounds the two subspecies of red fescues have been ranked higher for overall quality than the bentgrasses

X
Reykjavik

Apelsvoll

Nordlig, kontinental sone

X Apelsvoll

Landvik X

Landvik

Sørlig, kystnær sone

X Sydsjælland

	Visual turf quality (1-9)		
	2007-2010	2011-2014	Mean
	3	4	8
	5.6	5.6	5.6
	5.5	5.5	5.5
	4.4	4.6	4.5
	5.6	5.1	5.4
	5.0	4.9	5.0

NIBIO

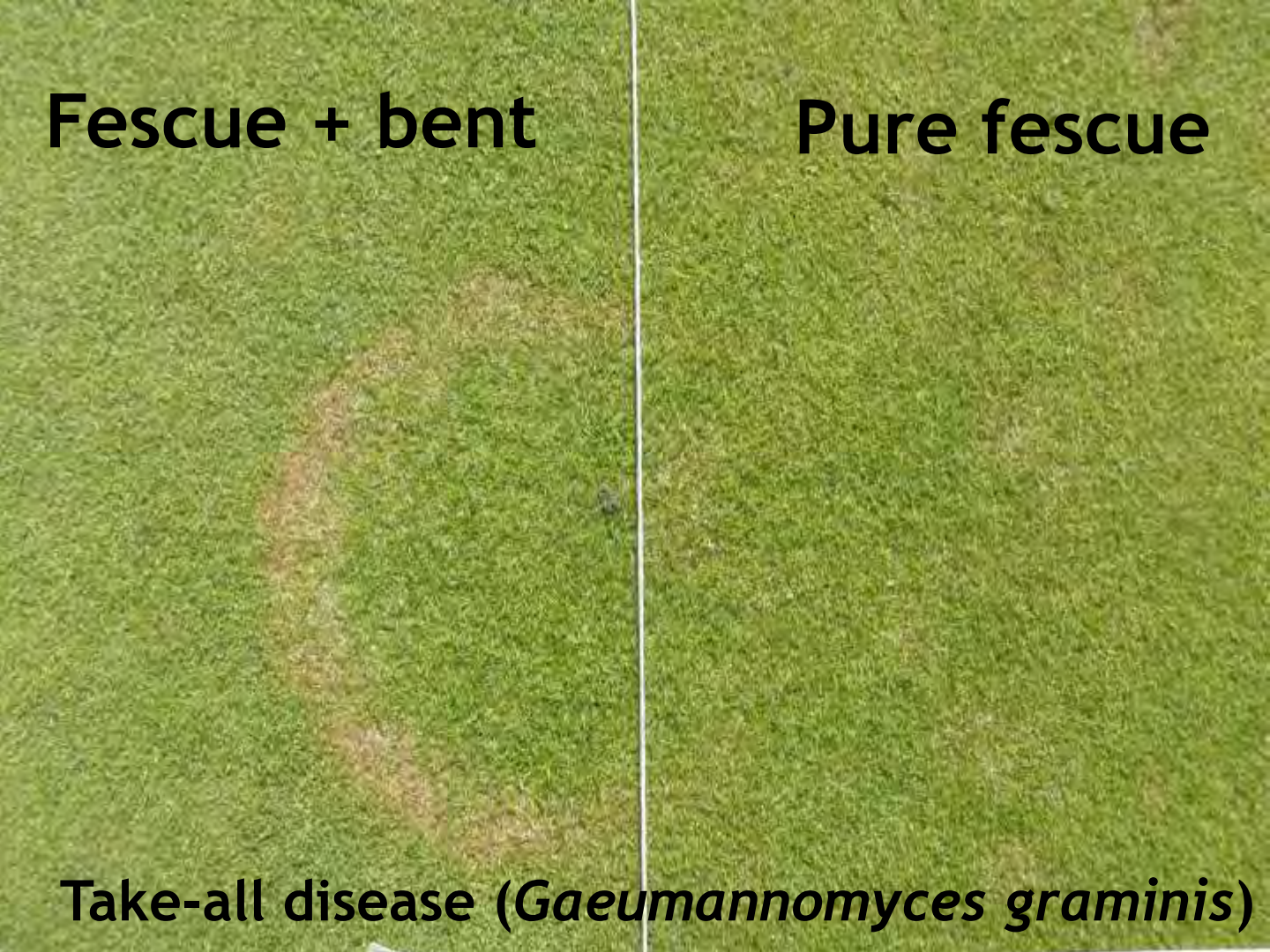
WHY IS THAT SO ?

STRONG AND WEAK CHARACTERISTICS OF RED FESCUE ON GREENS

Strong characteristics	
Strong against summer and winter diseases - less need for fungicides	

IN-SEASON DISEASE: MEAN VALUES FOR SPECIES IN (UNSPRAYED) SCANGREEN VARIETY TESTING, 2003-2014

	Total in-season diseases, % of plot area			
	2003-2006	2007-2010	2011-2014	Mean
No of trials	2	3	3	8
Chewings fescue	1	0	2	1
Slender creeping red fescue	1	1	1	1
Browntop/ colonial bentgrass	2	4	7	4
Velvet bentgrass	3	6	8	6
Creeping bentgrass	4	3	5	4



Take-all disease (*Gaeumannomyces graminis*)

MICRODOCHIUM PATCH

(FORMERLY OFTEN CALLED FUSARIUM)

In *Poa annua*

In *Agrostis* sp.

In *Festuca rubra*

Red fescue is not resistant, but patches are usually more superfical than the patches in bents and *Poa*

EXCEPTION FROM THE GENERAL DISEASE PATTERN:
RED THREAD (*LAETISARIA FUCIFORMIS*) IS USUALLY MORE PREVALENT IN FESCUES THAN IN POAS AND BENTS

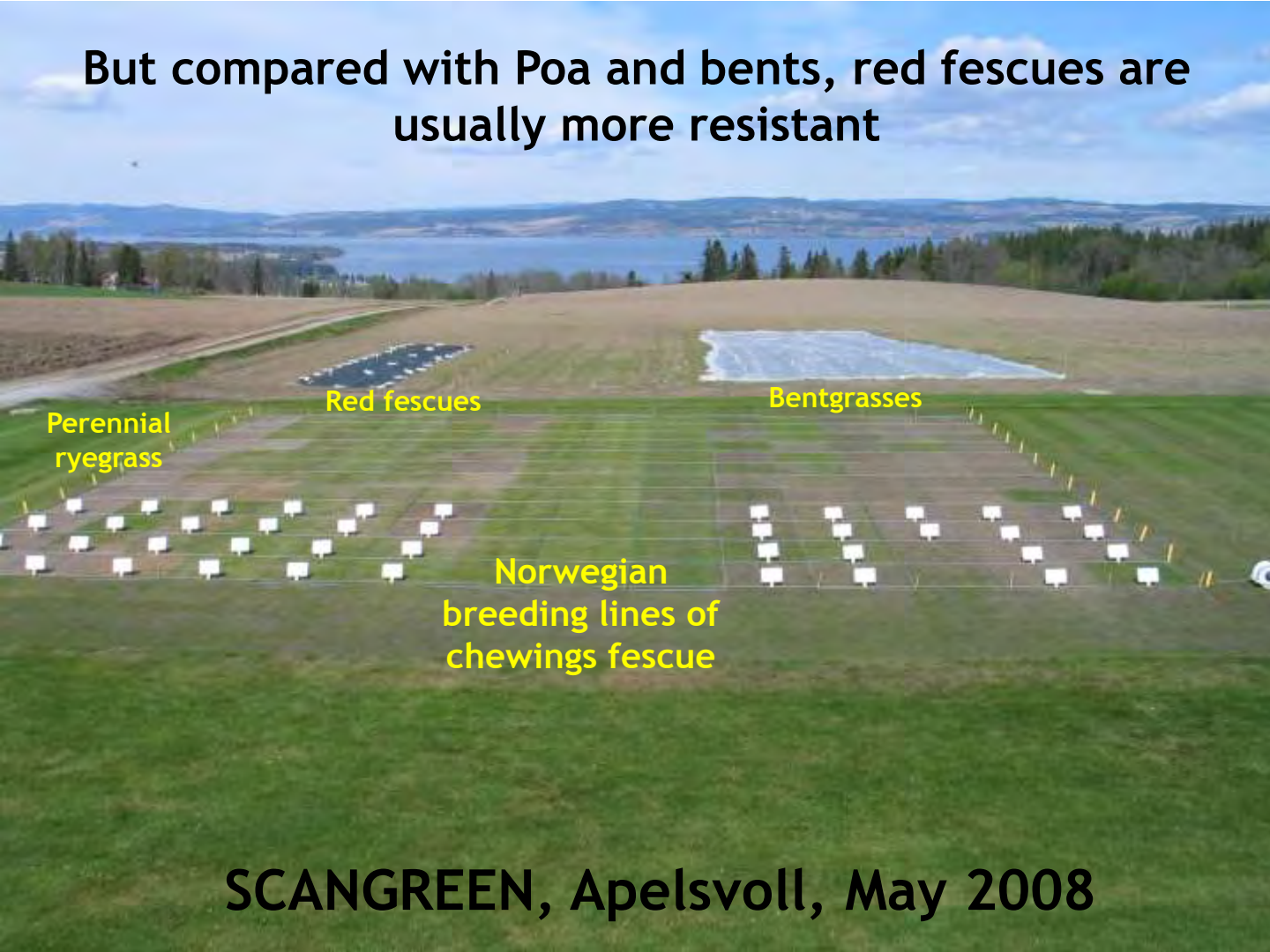
RED THREAD IS A TYPICAL 'LOW NITROGEN DISEASE'

WINTER DISEASES

Red fescue is affected by pink snow mold, and there are differences among varieties in susceptibility

SCANGREEN, Apelsvoll, May 2005

But compared with Poa and bents, red fescues are usually more resistant



SCANGREEN, Apelsvoll, May 2008

WINTER DAMAGE:
MEAN VALUES FOR SPECIES IN (UNSPRAYED) SCANGREEN VARIETY TESTING, 2003-2014

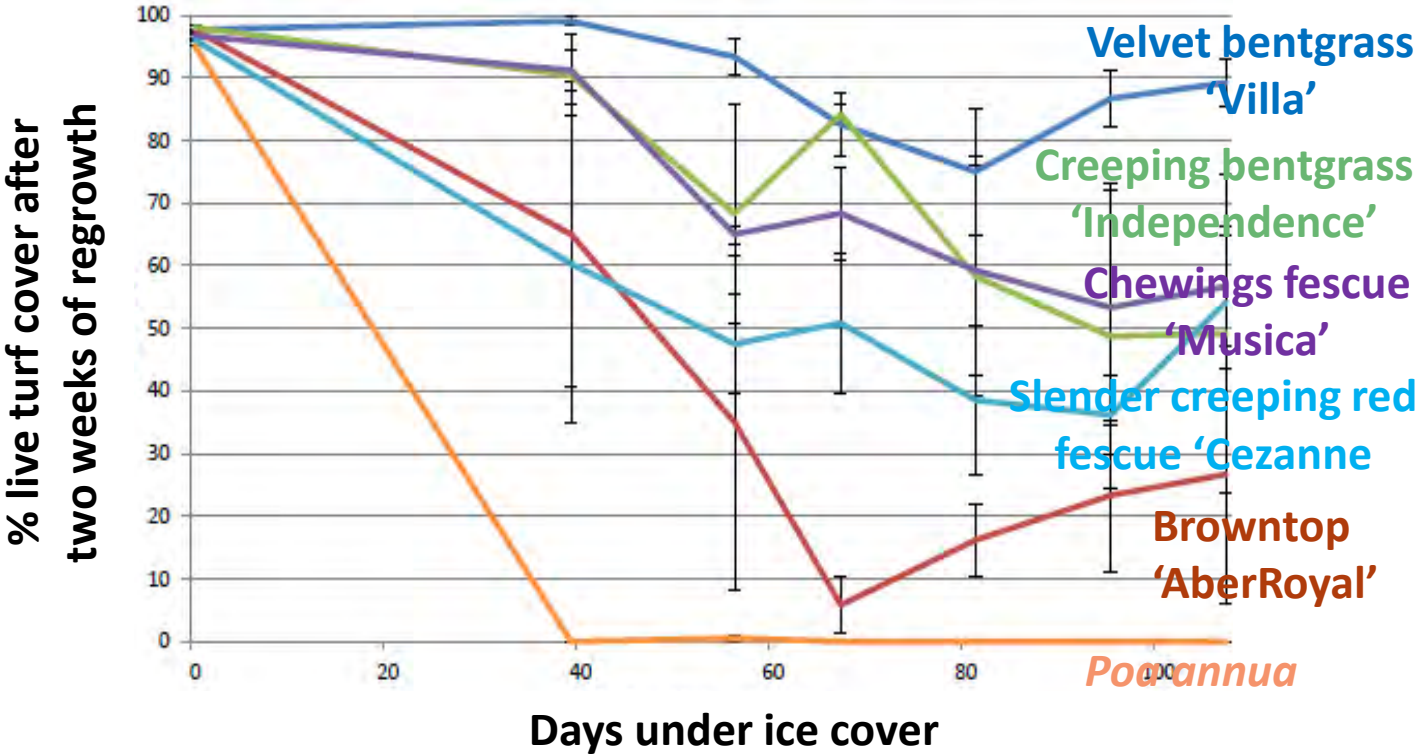
	Total in-season diseases, % of plot area				Total winter damage, % of plot area			
	2003-2006	2007-2010	2011-2014	Mean	2003-2006	2007-2010	2011-2014	Mean
No of trials	2	3	3	8	2	3	3	8
Chewings fescue	1	0	2	1	24	17	8	16
Slender creeping red fescue	1	1	1	1	22	22	9	18
Browntop/ colonial bentgrass	2	4	7	4	11	37	21	23
Velvet bentgrass	3	6	8	6	14	36	16	22
Creeping bentgrass	4	3	5	4	32	43	23	33

STRONG AND WEAK CHARACTERISTICS OF RED FESCUE ON GREENS

Strong characteristics	Weak characteristics
Strong against summer and winter diseases - less need for fungicides	Vulnerable to abiotic winter damages - ice encasement

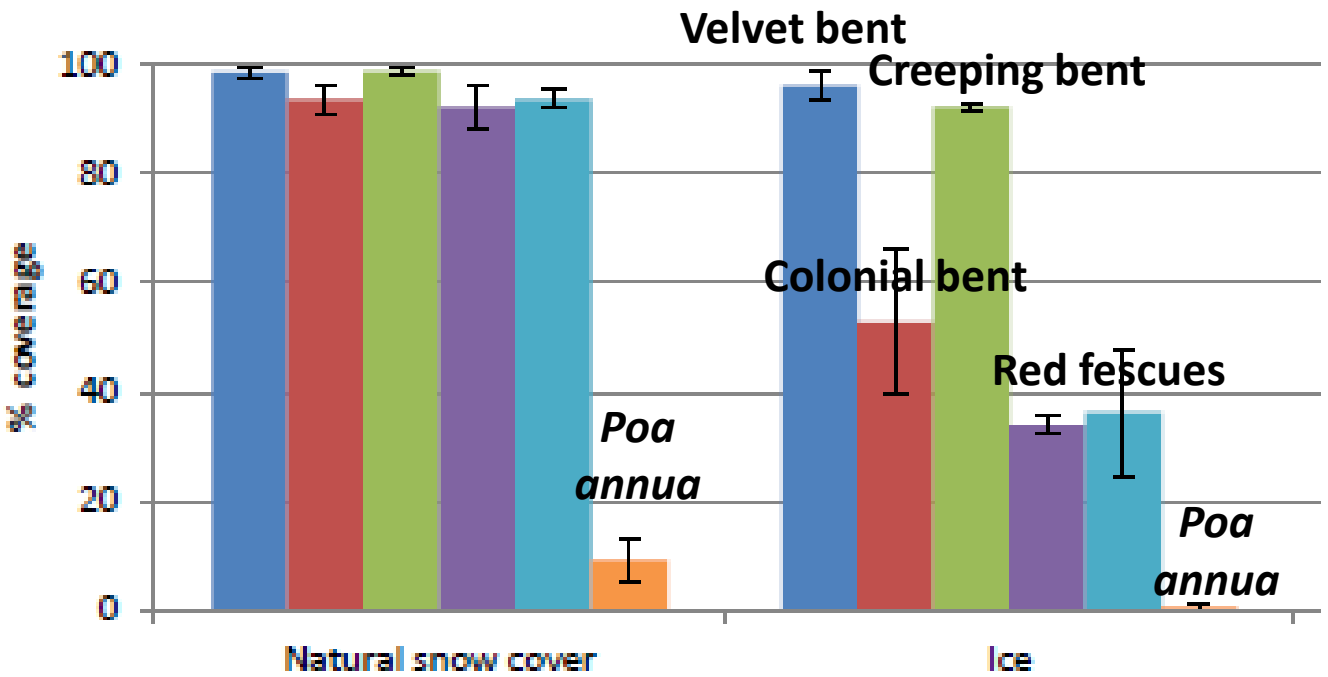

Fescues have less tolerance to ice encasement than velvet and creeping bent
Photo from Iceland, Bjarni Hannesson

SURVIVIAL OF DIFFERENT GRASS SPECIES UNDER ICE ON GOLF GREENS, 2013-14



From STERFs winter survival project (Waalen et al.)

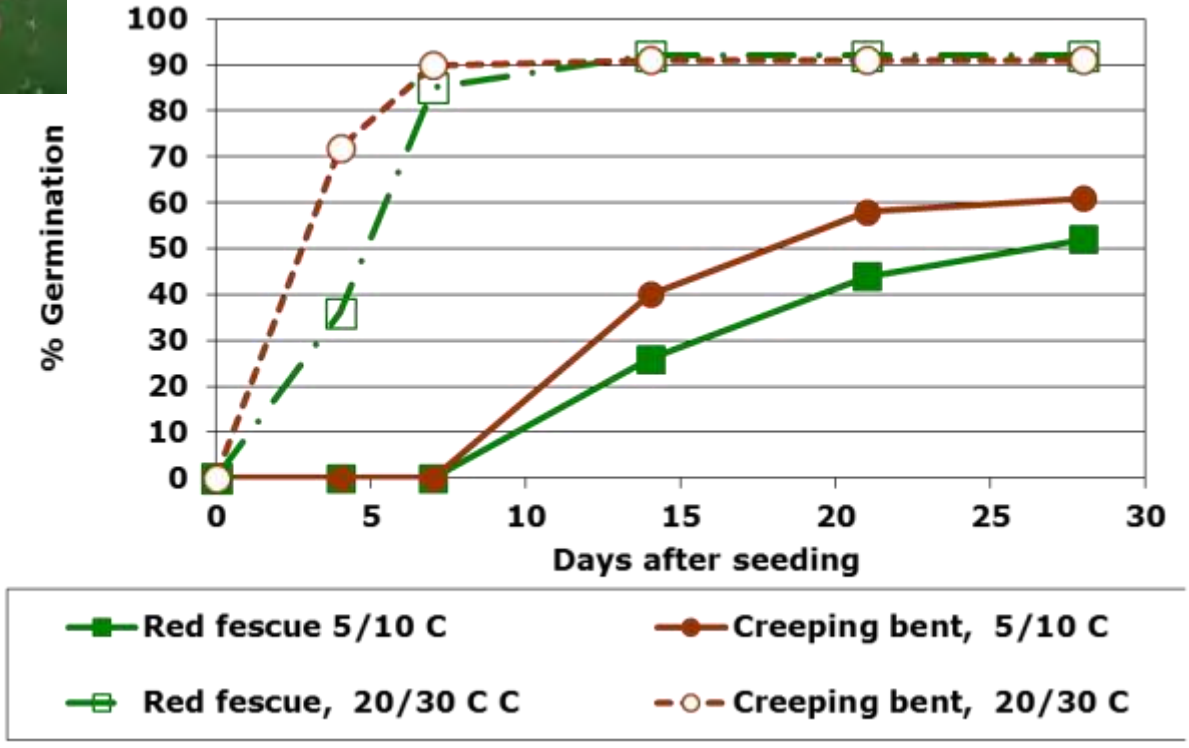
SURVIVIAL OF DIFFERENT GRASS SPECIES ON GOLF GREENS, 2012-13



STRONG AND WEAK CHARACTERISTICS OF RED FESCUE ON GREENS

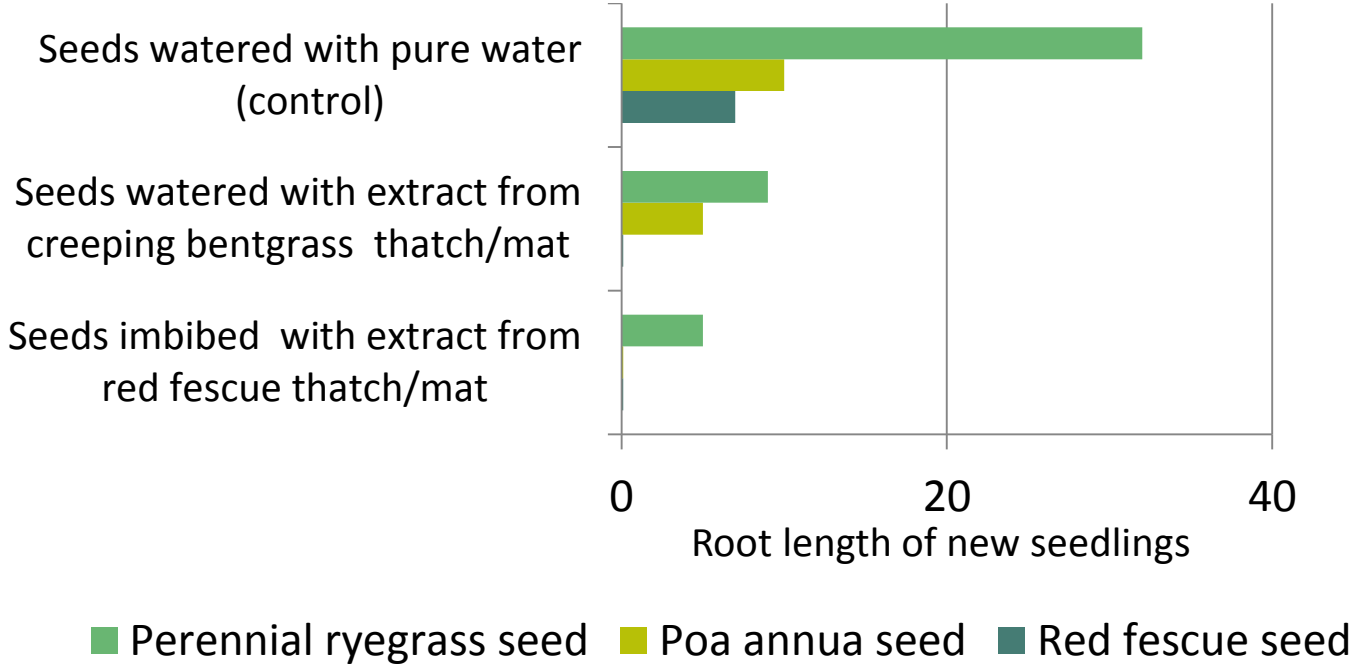
Strong characteristics	Weak characteristics
Strong against summer and winter diseases - less need for fungicides	Vulnerable to abiotic winter damages - ice encasement
	Relatively slow establishment and high sensivity to germination inhibitors ? - **Re**establishment from seed difficult

GERMINATION RATE AT DIFFERENT TEMPERATURES



Aamlid 1989

Does an ice-killed fescue green contain more germination inhibitors than an ice-killed creeping bentgrass green ?



Gussin & Lynch (1981)

Yes, it is more difficult to reestablish a red fescue green than a creeping bentgrass green (STERF research underway !)

Allelopathic effects of red fescue ?

Research at Cornell University:

- **Some red fescue varieties, e.g. 'Intrigue' secrete root exudates containing the amino acid m-thyrosine**
- **m-thyrosine inhibits germination and growth of *Poa annua***

,

Golf Course Management
76(2), 2008

More research needed !

STRONG AND WEAK CHARACTERISTICS OF RED FESCUE ON GREENS

Strong characteristics	Weak characteristics
Strong against summer and winter diseases - less need for fungicides	Vulnerable to abiotic winter damages - ice encasement
	Slow establishment and high sensivity to germination inhibitors ? - Reestablishment from seed difficult
	Low density - Susceptible to invasion by moss (and *Poa annua* ?)

NIBIO

Sterf
SCANDINAVIAN TURFGRASS

TILLER DENSITY:

MEAN VALUES FOR SPECIES IN SCANGREEN VARIETY TESTING, 2003-2014

	Tiller density (1-9)			
	2003-2006	2007-2010	2011-2014	Mean
No of trials	2	3	4	8
Chewings fescue	5.0	5.3	5.2	5.2
Slender creeping red fescue	5.4	5.3	5.2	5.3
Browntop/colonial bentgrass	6.0	6.0	6.2	6.1
Velvet bentgrass	8.4	7.6	7.9	8.0
Creeping bentgrass	6.5	6.5	6.4	6.5

IN THE SCANGREEN VARIETY TRIALS, LOWER DENSITY HAS RESULTED IN MORE MOSS IN FESCUES THAN IN BENTS

	% moss by end of trial			
	2003-2006	2007-2010	2011-2014	Mean
No of trials	0	1	3	8
Chewings fescue		3	4	3.5
Slender creeping red fescue		2	2	2.0
Browntop/ colonial bentgrass		0	2	1.0
Velvet bentgrass		0	1	0.5
Creeping bentgrass		0	0	0.0

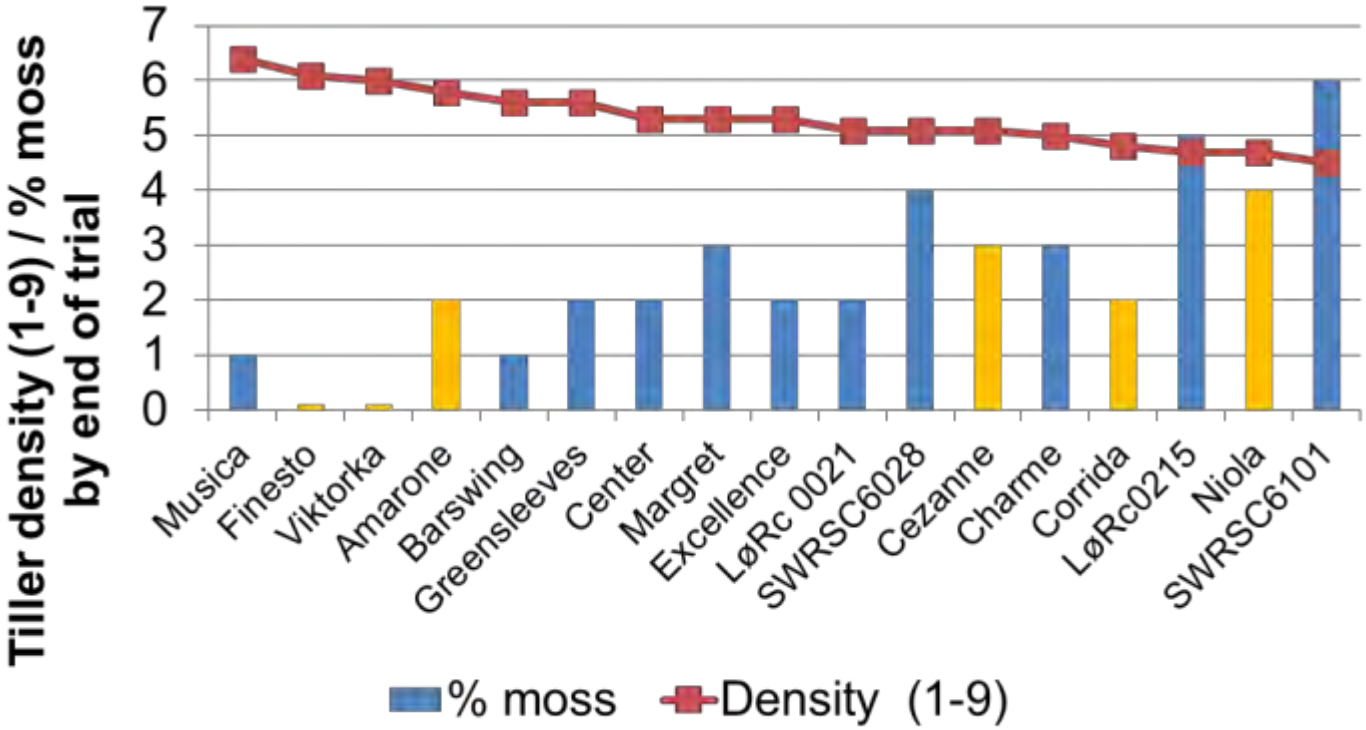
Photo: Yajun Chen

NIBIO

Sterf
SCANDINAVIAN TURFGRASS

Red fescue varieties with higher density are more comptetitive to moss invasion

(SCANGREEN 2007-2010, Landvik)



More *Poa annua* on fescue greens ?

- ***Poa annua*** **is usually more distinct/visible on fescue greens than on bentgrass greens.**

- **With high rainfall and the combination of low mowing height and high fertility, fescue greens are usually more invaded by *Poa annua* than bentgrass greens.**

- **However, but this may be different if we manage to take advantage of the greater differences in ecological adaptation between fescue and *Poa* than between Poa and bentgrasses.**

- **In SCANGREEN there hasn't been more *Poa annua* on fescue plots than on bentgrass plots (*Poa* has mainly occupied scars after take-all and other diseases)**

Photo: Yajun Chen

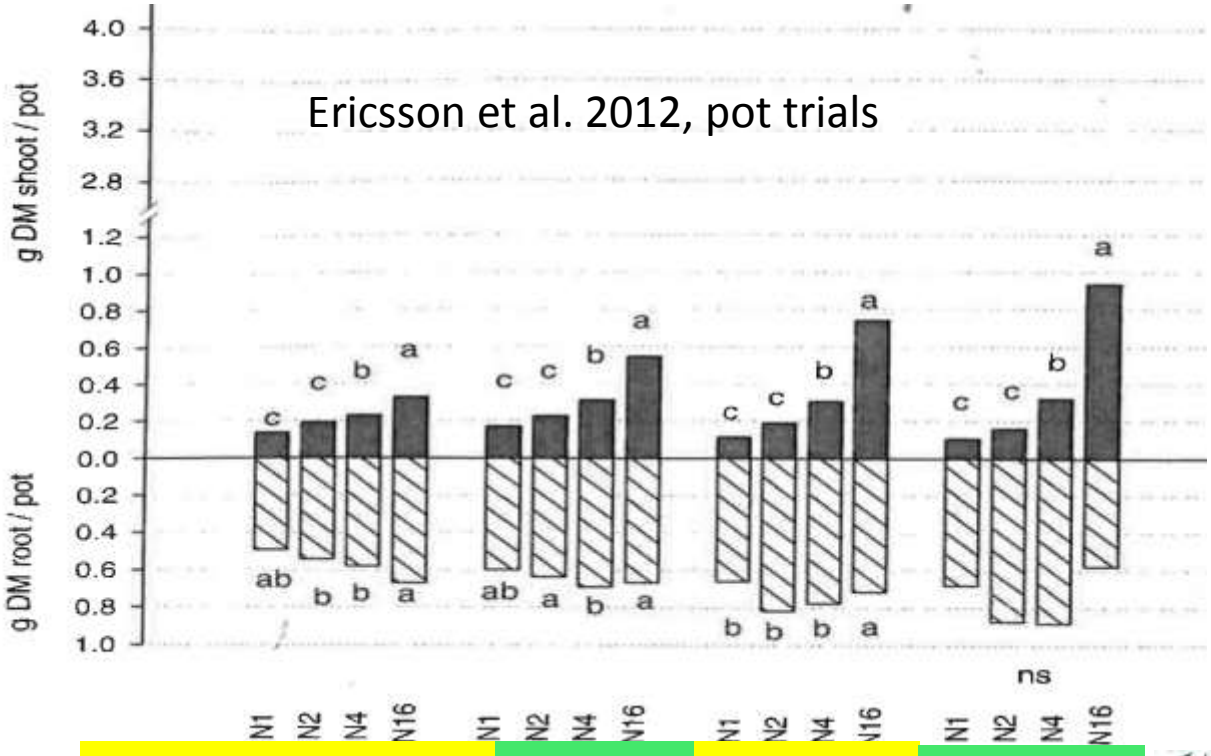
STRONG AND WEAK CHARACTERISTICS OF RED FESCUE ON GREENS

Strong characteristics	Weak characteristics
Strong against summer and winter diseases - less need for fungicides	Vulnerable to abiotic winter damages - ice encasement
Low nutrient requirement - savings on fertilizer	Relatively slow establishment and high sensivity to germination inhibitors ? - Reestablishment from seed difficult
	Low density - Susceptible to invasion by moss (and *Poa annua* ?)

NIBIO

Sterf
SCANDINAVIAN TURFGRASS

RED FESCUE'S 'LOW INPUT NATURE' IS REFLECTED IN ITS RESPONSE TO NITROGEN

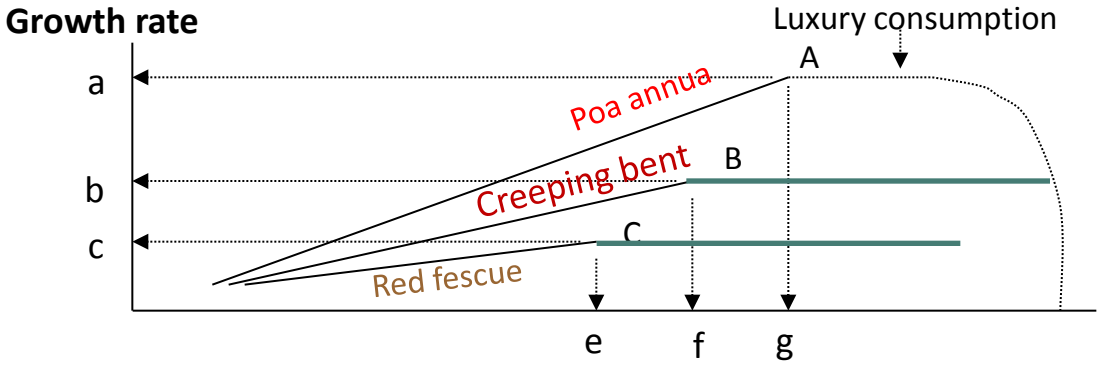


Slender creeping red fescue | Chewings fescue | Velvet bent | Creeping bent

NIBIO

Sterf SCANDINAVIAN TURFGRASS

Response to nitrogen



Fescue has less capacity for dry matter production and therefore requires less N than *Poa annua* and bents

If fertilization of greens with a mixed species compostion is increased, other species than red fescue will benefit from it and become more dominant

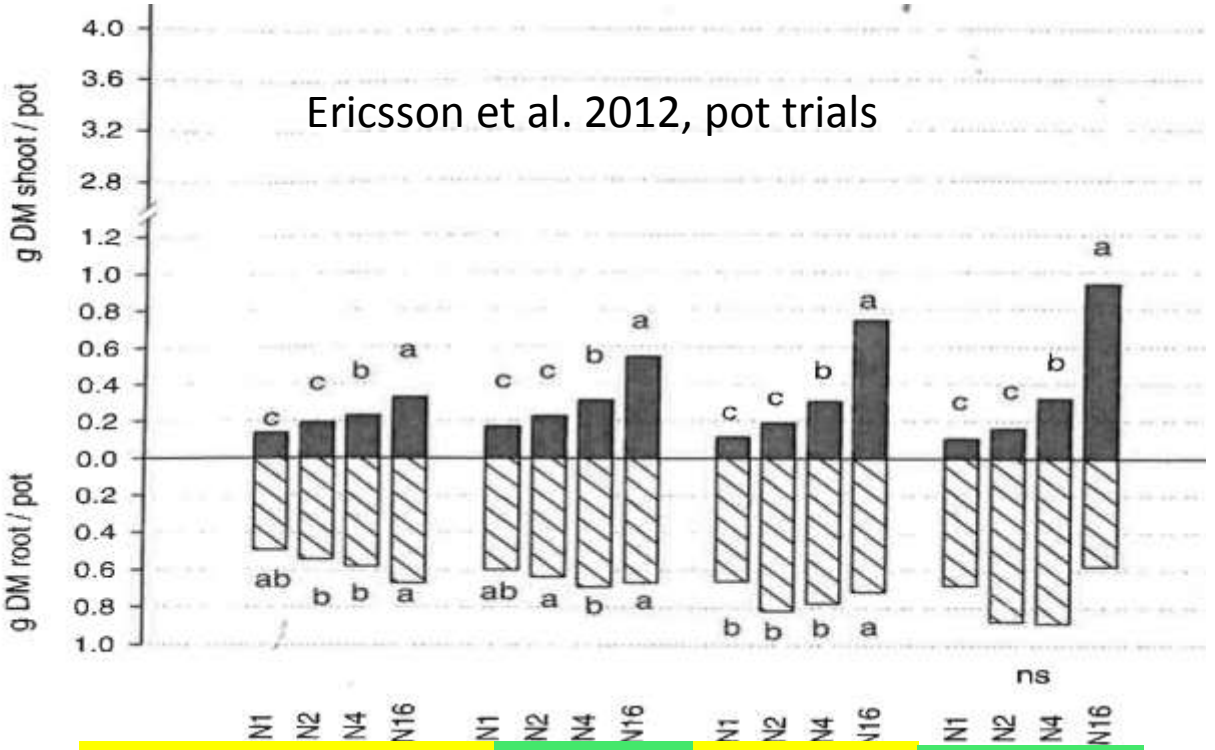
STRONG AND WEAK CHARACTERISTICS OF RED FESCUE ON GREENS

Strong characteristics	Weak characteristics
Strong against summer and winter diseases - less need for fungicides	Vulnerable to abiotic winter damages - ice encasement
Low nutrient requirement - savings on fertilizer	Relatively slow establishment and high sensivity to germination inhibitors ? - Reestablishment from seed difficult
Drought tolerant - less water needed for irrigation	Low density - Susceptible to invasion by moss (and *Poa annua* ?)

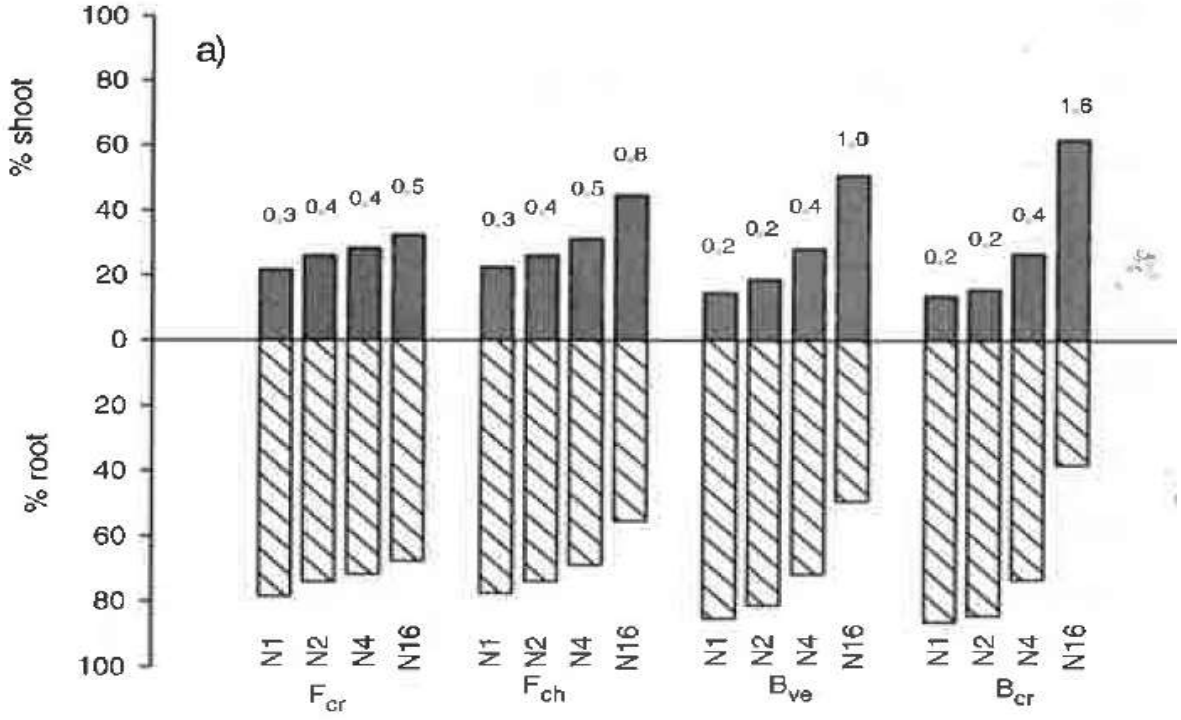
The most water-saving treatment in STERF's irrigation trials: Deficit irrigation once a week


Creeping bent
Red fescue
Drought avoidance due to deeper roots in red fescue ?
Photo: Agnar Kvalbein

BUT THERE ALWAYS MORE ROOTS IN THE FESCUES ?



TOP / ROOT RATIOS



Slender creeping red fescue	Chewings fescue	Velvet bent	Creeping bent

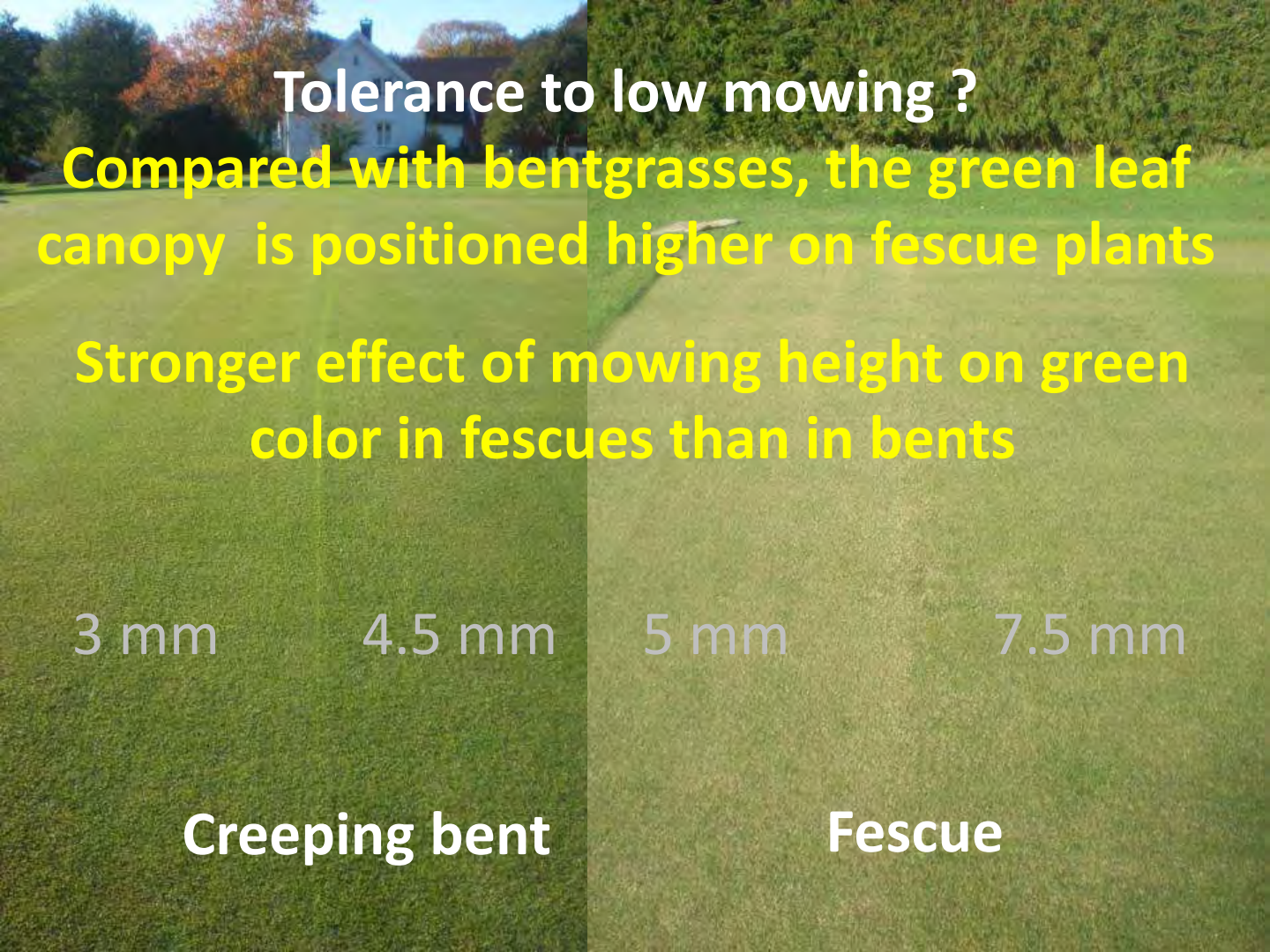
STRONG AND WEAK CHARACTERISTICS OF RED FESCUE ON GREENS

Strong characteristics	Weak characteristics
Strong against summer and winter diseases - less need for fungicides	Vulnerable to abiotic winter damages - ice encasement
Low nutrient requirement - savings on fertilizer	Relatively slow establishment and high sensivity to germination inhibitors ? - Reestablishment from seed difficult
Drought tolerant - less water needed for irrigation	Low density - Susceptible to invasion by moss (and *Poa annua* ?) - Low wear tolerance
	Upright growth - Less tolerance to close mowing - No or limited development of rhizomes - Low recuperative capacity

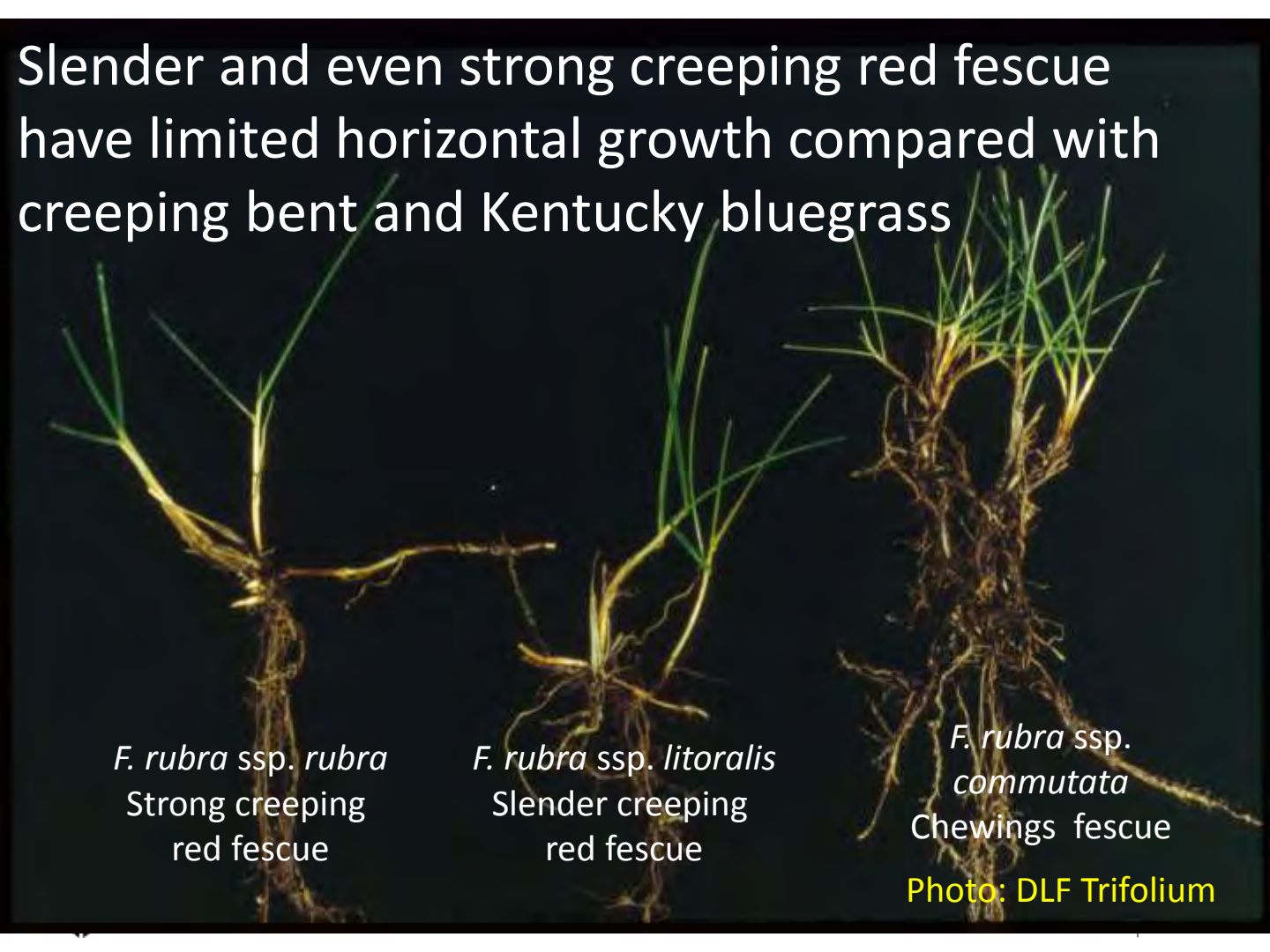
THE UPRIGHT FESCUE PLANT

GROWTH HABIT: RED FESCUE ALLOCATES MOST RESOURCES TO UPRIGHT GROWTH

	Daily height growth, mm			
	2003-2006	2007-2010	2011-2014	Mean
No of trials	2	2	3	8
Chewings fescue	1.1	1.0	1.0	1.03
Slender creeping red fescue	1.0	0.9	1.0	0.97
Browntop/colonial bentgrass	0.9	0.7	0.8	0.80
Velvet bentgrass	0.5	0.4	0.5	0.47
Creeping bentgrass	0.5	0.6	0.7	0.60


Tolerance to low mowing ?
Compared with bentgrasses, the green leaf canopy is positioned higher on fescue plants
Stronger effect of mowing height on green color in fescues than in bents
3 mm
4.5 mm
5 mm
7.5 mm
Creeping bent
Fescue

Slender and even strong creeping red fescue have limited horizontal growth compared with creeping bent and Kentucky bluegrass

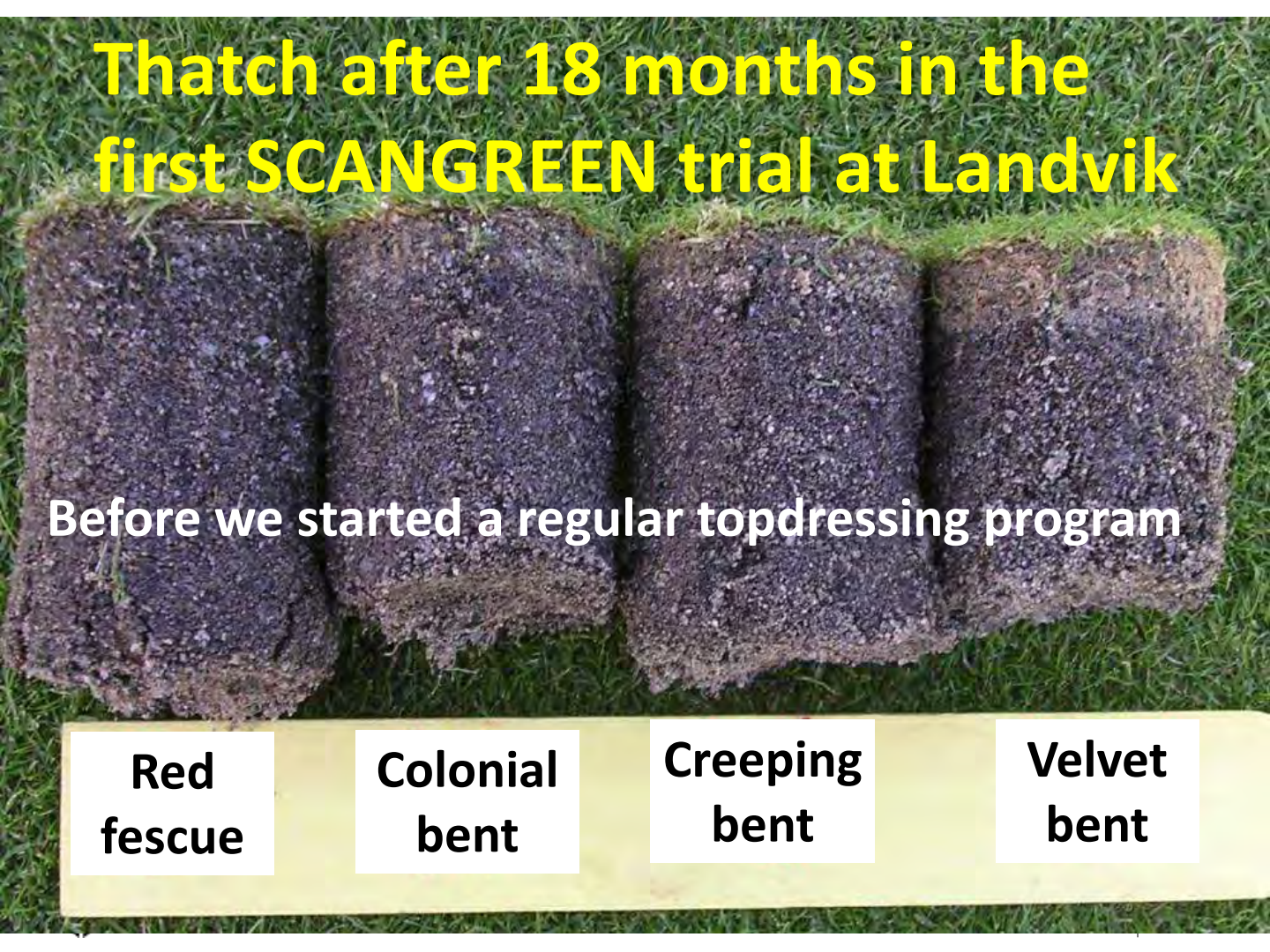


Low input fescues are not wear tolerant and have poor recuperative capacity

STRONG AND WEAK CHARACTERISTICS OF RED FESCUE ON GREENS

Strong characteristics	Weak characteristics
Strong against summer and winter diseases - less need for fungicides	Vulnerable to abiotic winter damages - ice encasement
Low nutrient requirement - savings on fertilizer	Relatively slow establishment and high sensivity to germination inhibitors ? - Reestablishment from seed difficult
Drought tolerant - less water needed for irrigation	Low density - Susceptible to invasion by moss (and *Poa annua* ?) - Low wear tolerance
Dark and lignified thatch - hard greens (too hard ?) - different microbial flora	Upright growth - Less tolerance to close mowing - No or limited development of rhizomes - Low recuperative capacity

Thatch after 18 months in the first SCANGREEN trial at Landvik




Mat on 2-3 year old greens after weekly topdressing (8 mm sand/yr)
Red fescue
Creeping bentgrass

Surface hardness

Students testing golf ball bounce at Landvik

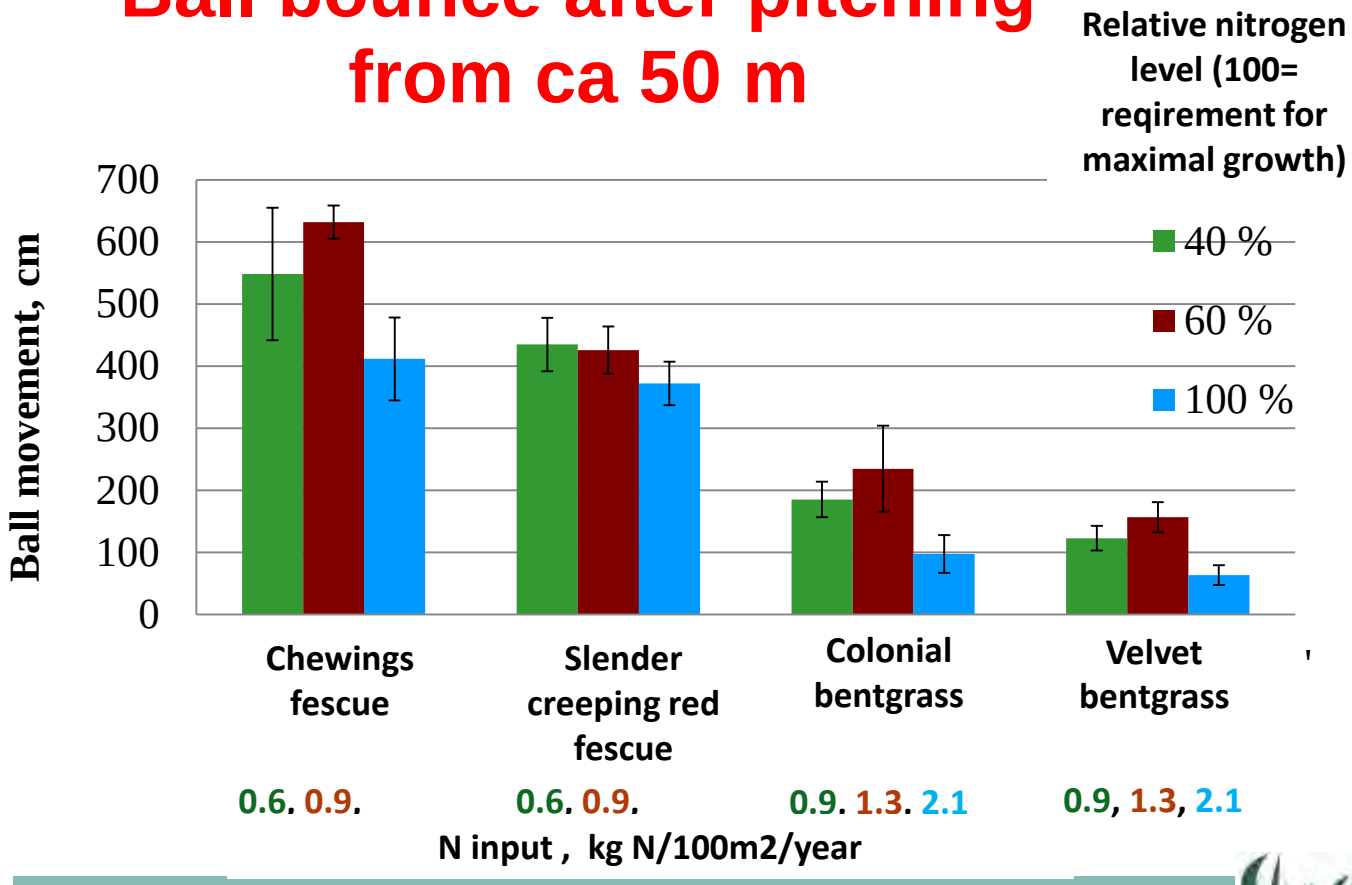
Photo: Agnar Kvalbein

Surface hardness

Measuring distance from ball mark

Photo: Agnar Kvalbein

Ball bounce after pitching from ca 50 m




FINALLY SOME CHARACTERISTICS OF LOW-INPUT FESCUES OF SPECIAL RELEVANCE
FOR FAIRWAYS AND ROUGHS

HERBICIDE TOLERANCE

The following herbicides can be used for control of other grasses in fine fescues (most of them are labelled in red fescue seed production in Scandinavia)

Product on Scandinavian market	Active ingredient
Agil	propaquizafop
Boxer	prosulfocarb
Fusilade	fluazifop-P-butyl
Focus Ultra	cycloxydim
Puma Extra	fenoxaprop-P-ethyl
Axial (Rescue[1])	pinoxaden
Select	chletodim
Roundup (+ other brand names) ??	Glyphosate ??

[1] Turf formulation not approved in Scandinavia.

What is sustainable herbicide use on wall-to-wall fescue courses ?

TOLERANCE TO SUBMERSION / HIGH WATER TABLES

Relative Submersion Tolerance of 12 Turfgrasses (Beard, 1973)

Submersion Tolerance	*Turfgrass Species*
Excellent	Buffalograss Bermudagrass Creeping Bentgrass
Good	Timothy Rough Bluegrass
Medium	Meadow Fescue Kentucky Bluegrass
Fair	Crested Wheatgrass Annual Bluegrass Perennial Ryegrass
Poor	Red Fescue

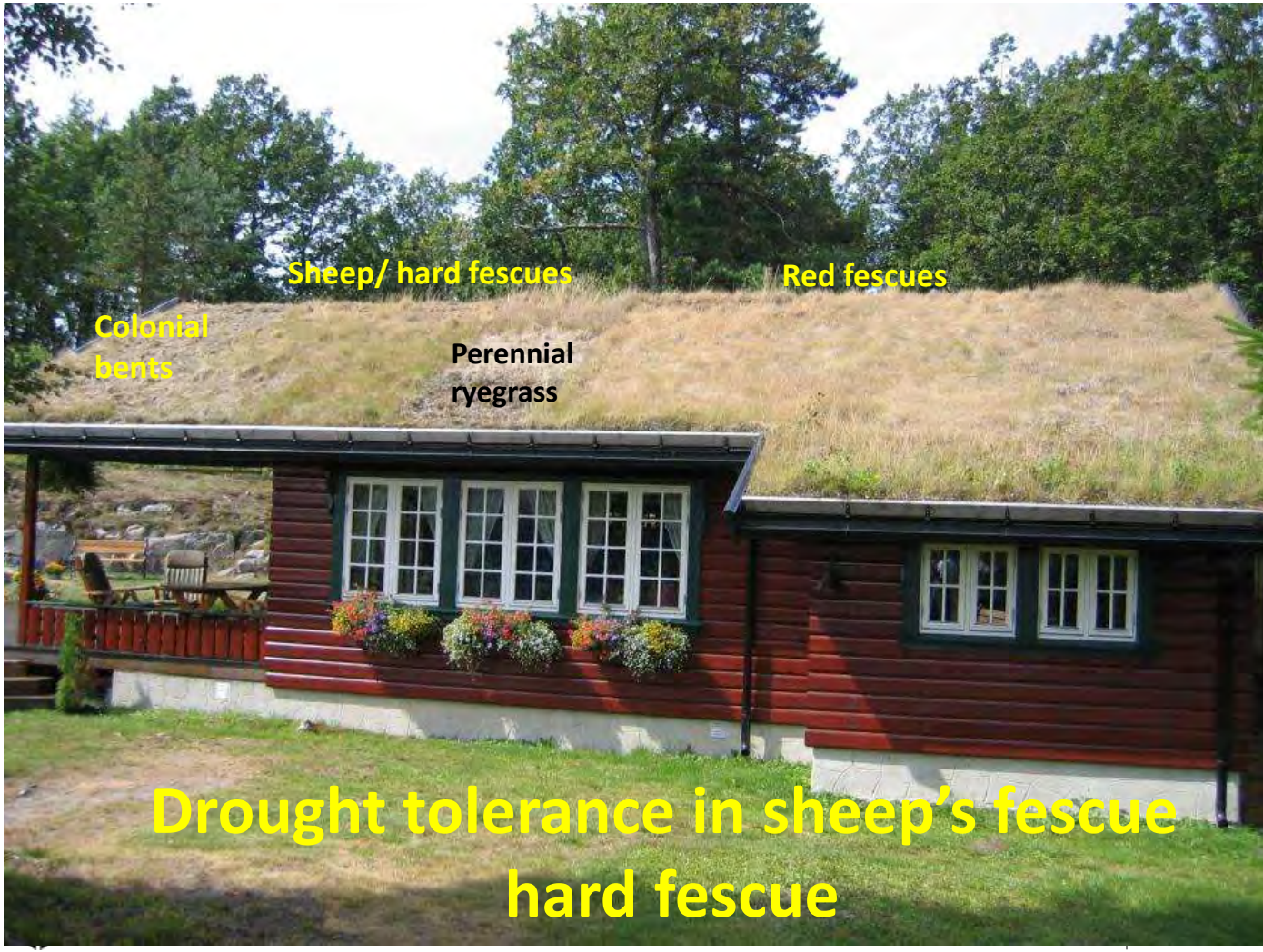
MORE RESEARCH NEEDED !

2007/07/11 08:49

Photo: Morten Fuglehaug

HARD AND SHEEP'S FESCUES

Strong characteristics	Weak characteristics
Very drought tolerant - Keeps green color throughout year, even during dry periods - Quick to green up after drought	Do not tolerate high water tables
Low nutrient requirements	Poor wear tolerance
	Low (no ?) recuperative capacity
	Slow in establishment
Mostly poor winter hardiness	


Sheep/ hard fescues
Red fescues
Colonial bents
Perennial ryegrass
Drought tolerance in sheep's fescue
hard fescue

Hard fescues and sheeps' fescues may have interesting features in low-input fairways and roughs

Native seeds of sheep's fescue: The ideal grass for high-biodiversity, flowering meadows (high roughs ?)