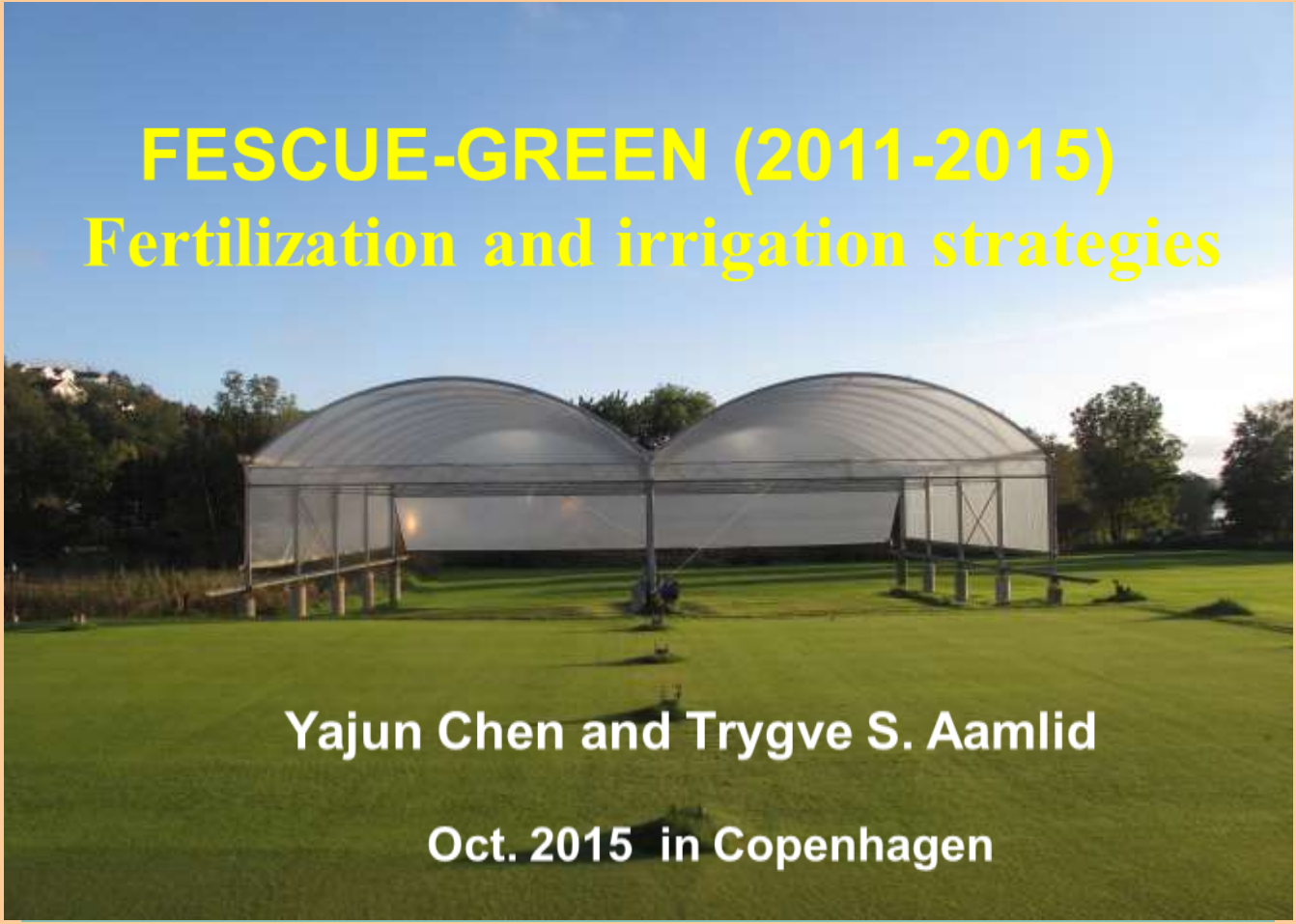
FESCUE-GREEN (2011-2015)
Fertilization and irrigation strategies



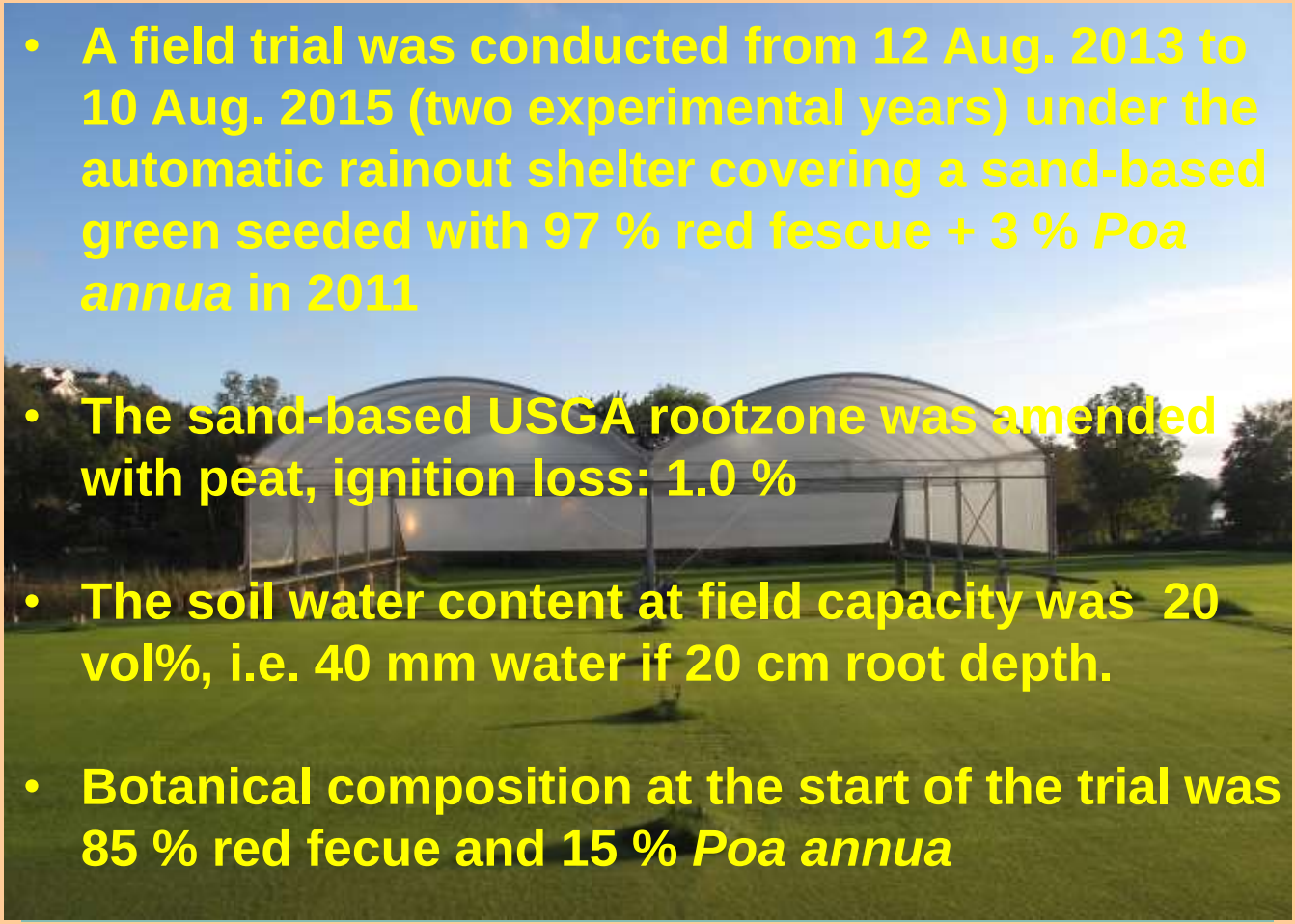
Yajun Chen and Trygve S. Aamlid

Oct. 2015 in Copenhagen

BACKGROUND

- **We all know that red fesuce is a 'low input species' in terms of irrigation and nitrogen requirements.**
- **But virtually no information is available about how sand-based fescue greens react to various distribution patterns of a limited amount of water and fertilizer – and also, the implications of excess water for turf quality.**

Objective: **to determine the influence of irrigation strategies and seasonal fertilizer distribution on turf quality, playability and competition from *Poa annua* on pure red fescue greens.**



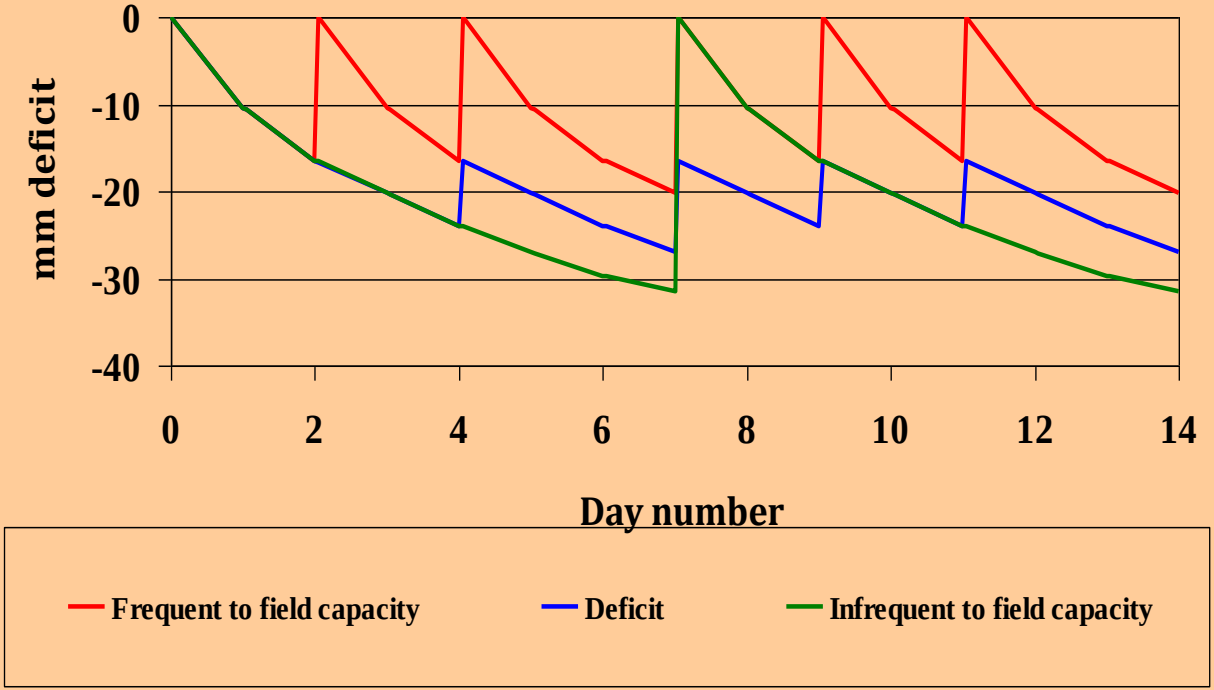
- **A field trial was conducted from 12 Aug. 2013 to 10 Aug. 2015 (two experimental years) under the automatic rainout shelter covering a sand-based green seeded with 97 % red fescue + 3 % *Poa annua* in 2011**

- **The sand-based USGA rootzone was amended with peat, ignition loss: 1.0 %**

- **The soil water content at field capacity was 20 vol%, i.e. 40 mm water if 20 cm root depth.**

- **Botanical composition at the start of the trial was 85 % red fecue and 15 % *Poa annua***

Three principally different irrigation strategies



Split-plot plan for experiment under rainout-shelter, Landvik, 12 Aug. 2013 – 10 Aug. 2015

Factor 1: Irrigation (main plots)

1. No drought stress. Irrigation to field capacity 3x per week (20 vol% water) (FC3)
2. Deficit irrigation to 60 % of field capacity 3x per week (12 vol% water) (DEF3)
3. Deep and infrequent irrigation to field capacity, 1x per week (FC1)
4. As treatm.2 but with irrigation to FC every 2 wk (DEF-FC) (Aug. 13-Aug.14)

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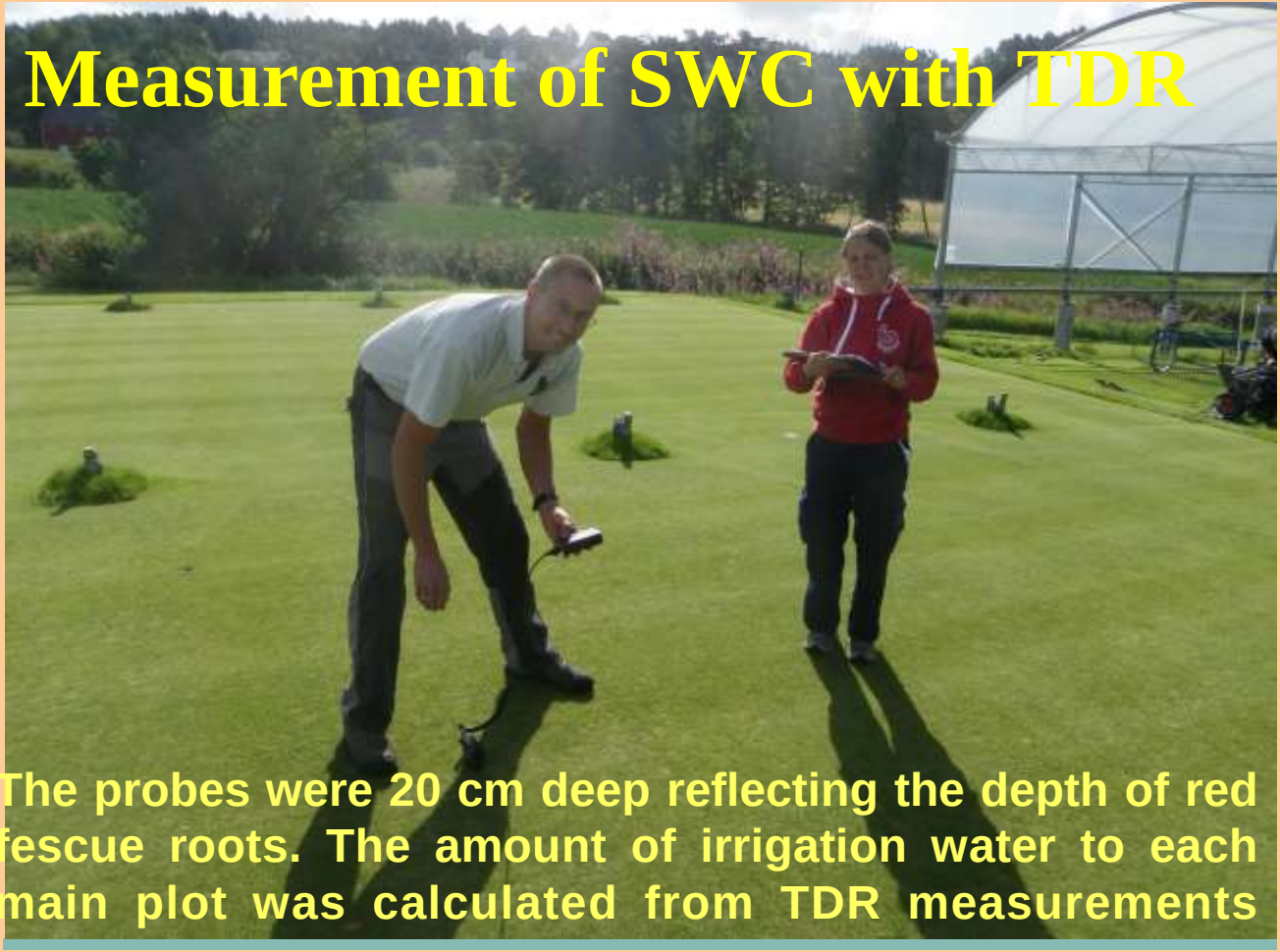
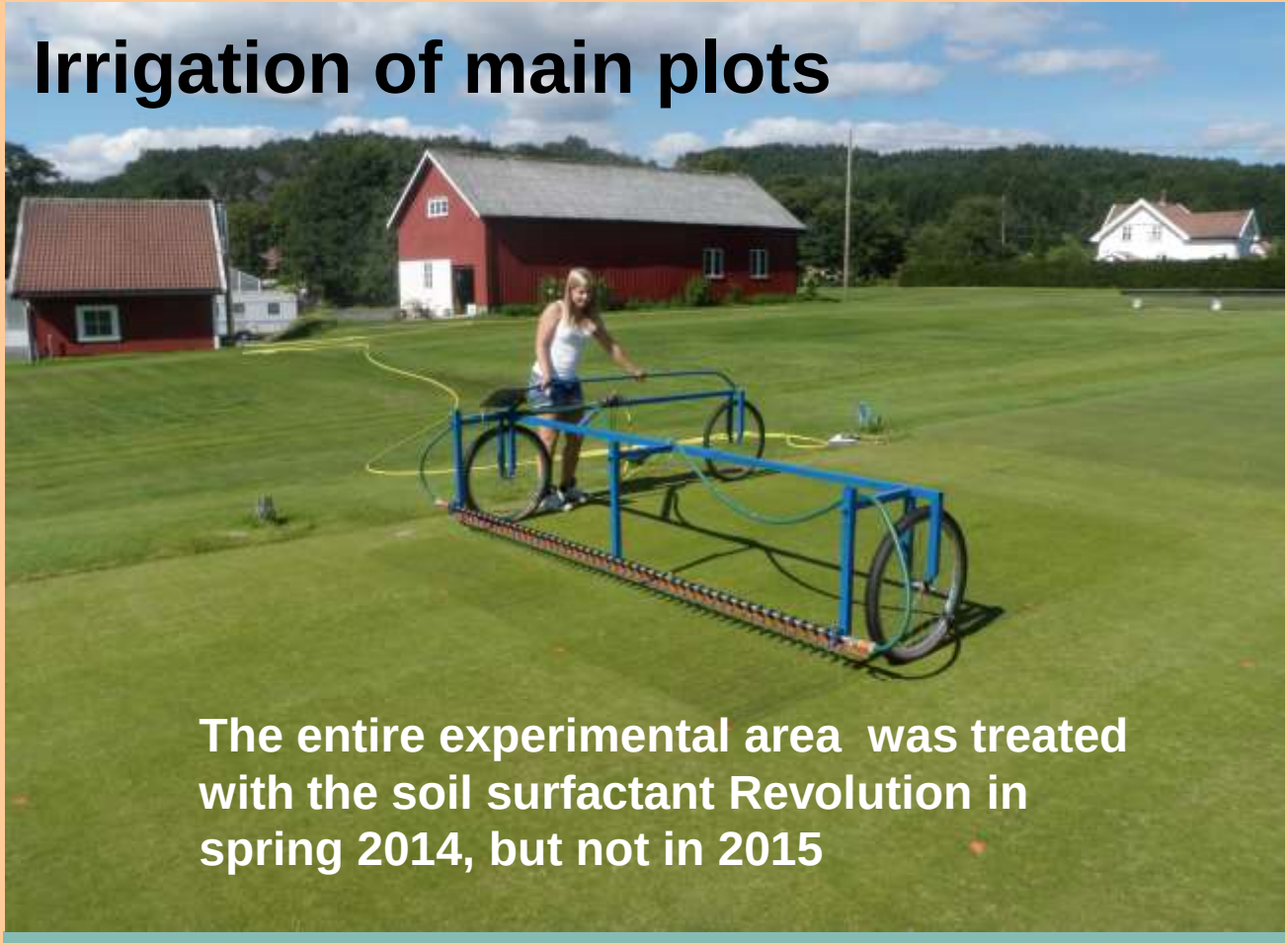
   b) Deficit irrigation to 60 % of FC 1x per week (DEF1) (Aug.14-Aug.15)

Measurement of SWC with TDR



The probes were 20 cm deep reflecting the depth of red fescue roots. The amount of irrigation water to each main plot was calculated from TDR measurements

Irrigation of main plots



The entire experimental area was treated with the soil surfactant Revolution in spring 2014, but not in 2015

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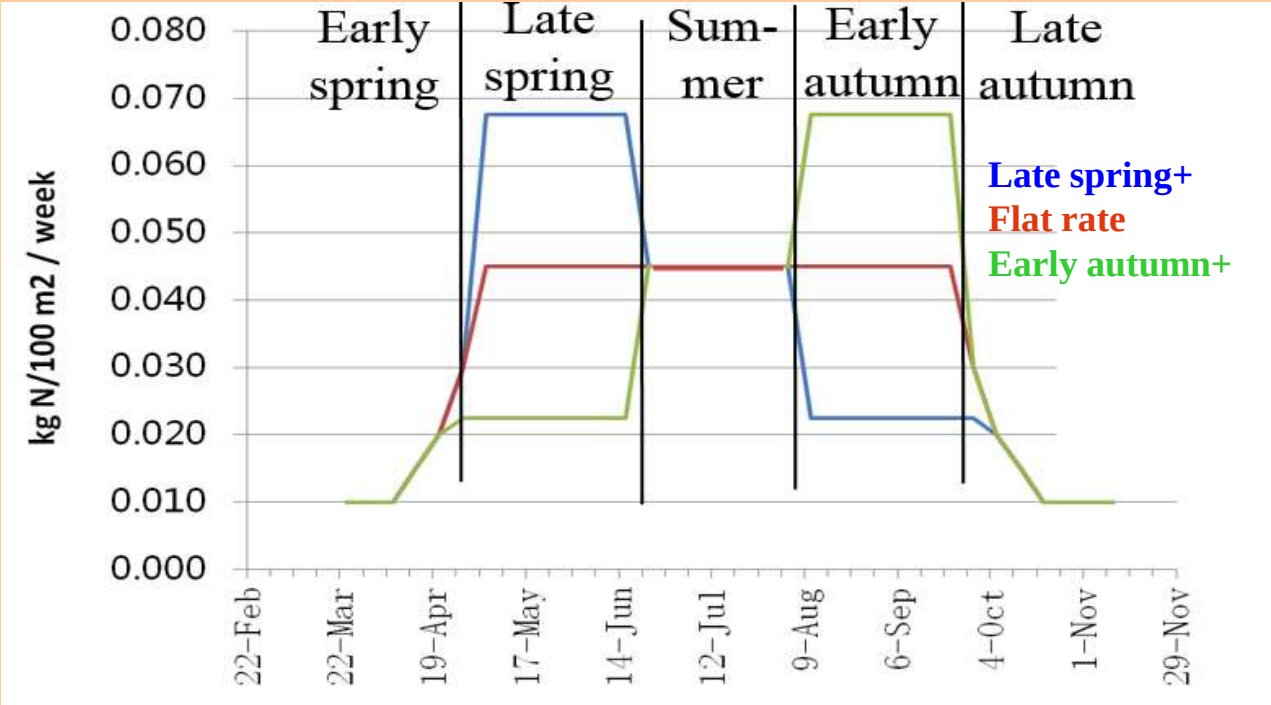
Factor 2: Fertilizer distribution (subplots)

a. Late spring+

b. Flat rate

c. Early autumn+

Seasonal fertilizer distribution treatments



- **Weekly inputs of Wallco 5-1-4, complete liquid fertilizer**
- **Seasonal N rate: 11.0 g N/m^2 in all treatments**

Seasonal fertilizer distribution

Amount of seasonal fertilizer distribution in different periods

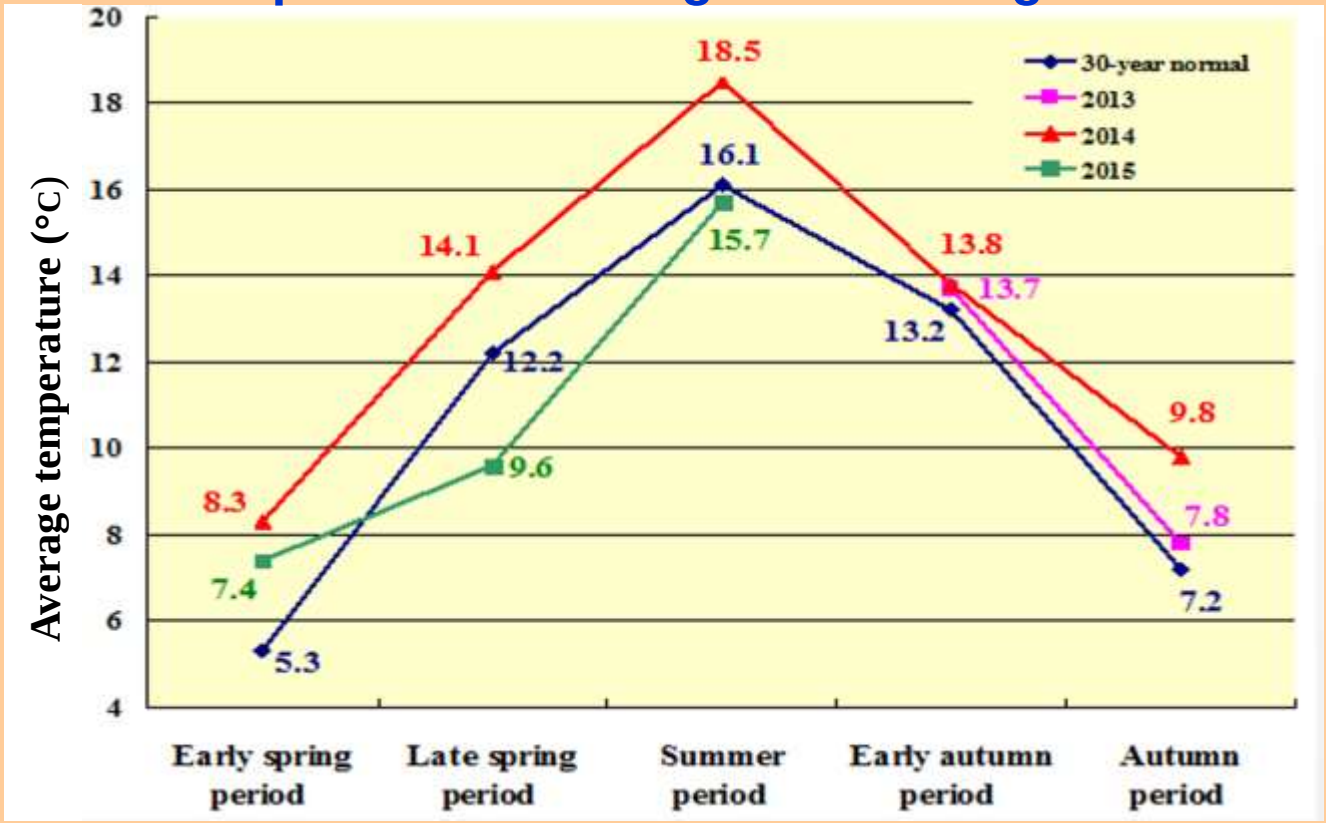
		Seasonal fertilizer treatments		
Different periods	**Time of period**	**Late Spring+**	**Flat rate**	**Early autumn+**
Early spring period	Until 27 April	0.68 (6.2%)	0.68 (6.2%)	0.68 (6.2%)
Late spring period	5 May-15 Jun	4.76 (43.2%)	3.15 (28.9%)	1.61(14.6%)
Summer period	22 Jun-3 Aug	3.15 (28.9%)	3.15 (28.9%)	3.15 (28.9%)
Late summer period	10 Aug-21 Sept	1.61 (14.6%)	3.15 (28.9%)	4.76 (43.2%)
Autumn period	28 Sept-2 Nov	0.78 (7.1%)	0.78 (7.1%)	0.78 (7.1%)
Total Nitrogen ($g.m^{-2}$)		11.00	11.00	11.00

Different fertilizer distribution treatments on subplots (strips)

Fertilizer strips in early autumn


Wear treatments 3x per week

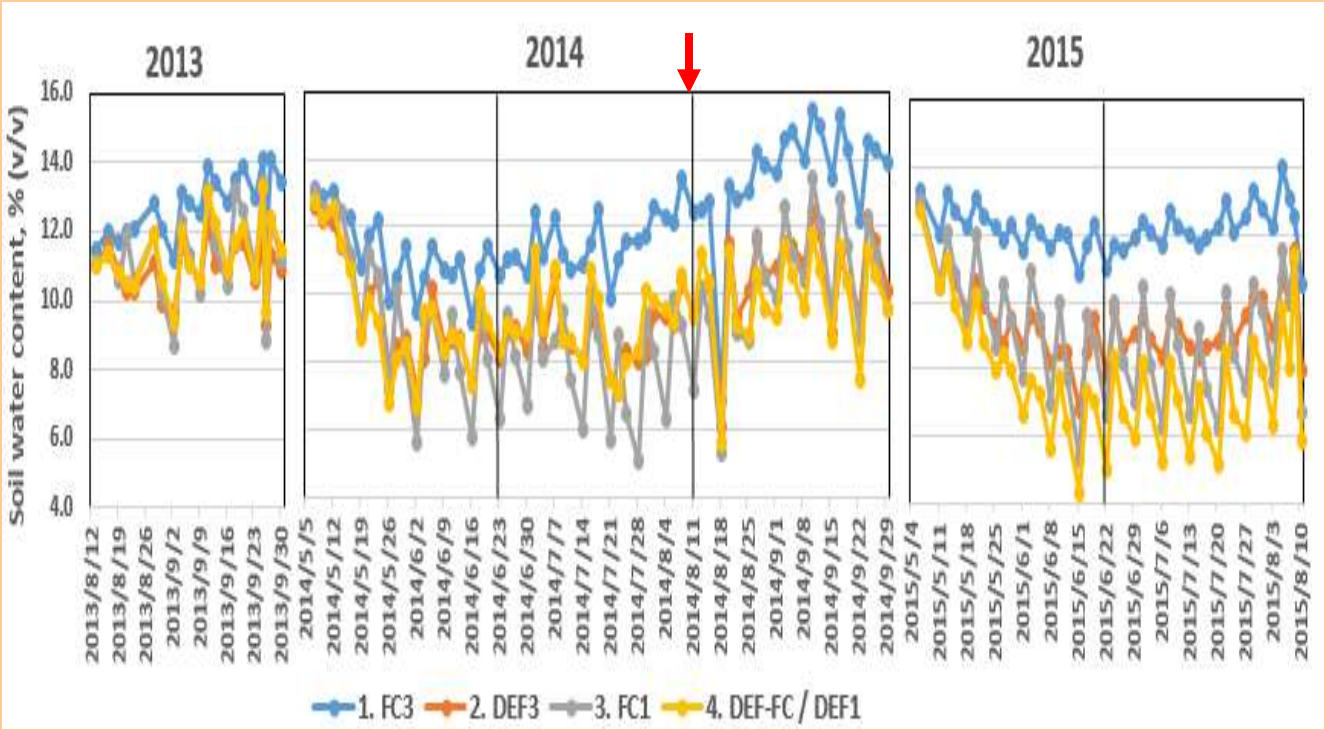
Mean temperature during different periods from Aug. 2013 to Aug. 2015



RESULTS: Soil water content

Experimental year 1: 12 Aug. 2013 - 11 Aug. 2014

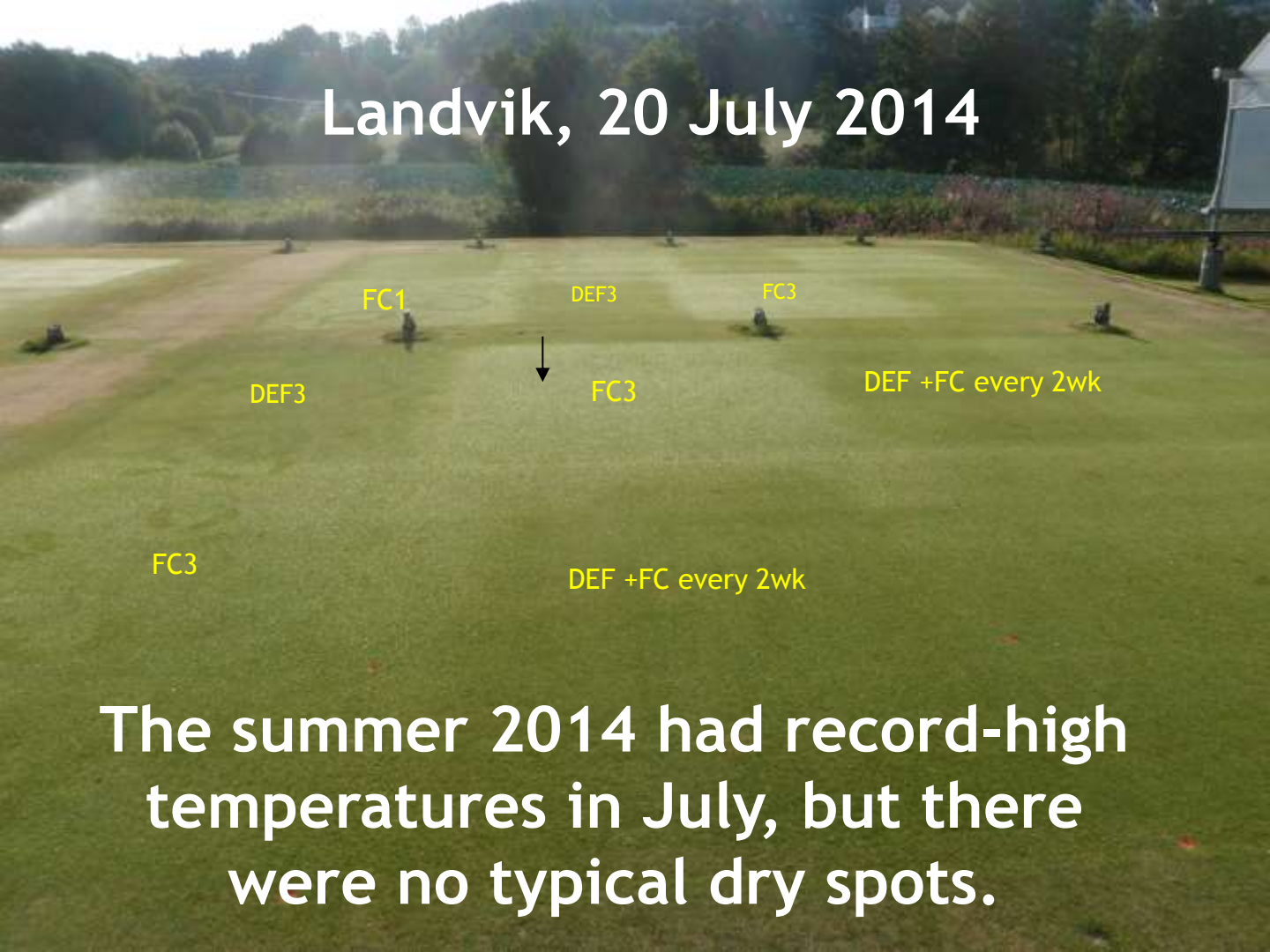
Experimental year 2: 11 Aug. 2014 - 10 Aug. 2015



Amount of irrigation water

	From 13 Aug. 2013 to 11 Aug. 2014			From 12 Aug. 2014 to 10 Aug. 2015		
Irrigation regime	Total irrigation, mm	Number of irrigations	Mm water per irrigation (average)	Total irrigation, mm	Number of irrigations	Mm water per irrigation (average)
1. To FC 3x per week	1119 a	63 a	17.8 b	930 a	63 a	14.8 b
2. Deficit 3x per week	291 d	57.3 b	5.1 d	288 c	58.3 b	4.9 d
3. To FC 1x per week	536 b	21.5 d	25.0 a	511 b	21 c	24.3 a
4. Deficit 3x per wk + to FC every 2 weeks / Deficit 1x per week	398 c	47.8 c	8.3 c	211 c	21 c	10.1 c
P-value	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001

Landvik, 20 July 2014



The summer 2014 had record-high temperatures in July, but there were no typical dry spots.

Visual turf quality (1-9)

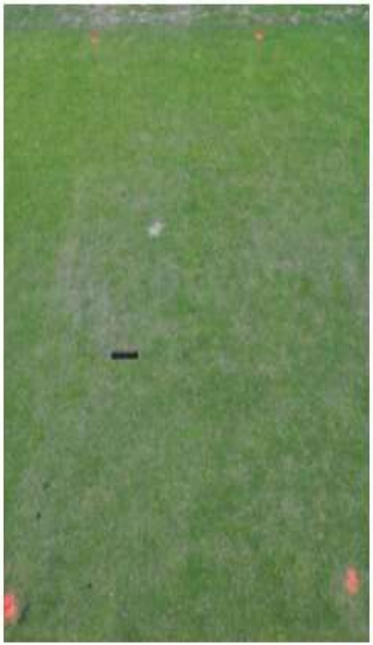
	2013-2014				2014-2015			
	Early autumn	Late spring	Summer	Mean, Expt. Yr 1	Early autumn	Late spring	Summer	Mean, Expt. Yr 2
Main effect irrigation								
1. To FC 3x per week	6.7	6.8	6.7	6.7	6.1 a	5.0	5.5 a	5.5 a
2. Deficit 3x per week	6.6	6.5	6.1	6.4	5.4 b	5.1	5.1 b	5.2 b
3. To FC 1x per week	6.7	6.6	6.0	6.4	5.5 b	5.1	5.0 b	5.2 ab
4. Deficit 3x per wk + to FC every 2 weeks / Deficit 1x per week	6.8	6.7	6.2	6.5	5.4 b	4.7	4.6 c	4.9 b
P-value	>0.10	>0.10	>0.10	>0.10	0.060	>0.10	0.0034	0.016
Main effect fertilizer distribution								
a) Late spring +	6.3 c	7.0 a	6.5 a	6.6	5.4 b	5.5 a	5.4 a	5.4 a
b) Flat rate	6.7 b	6.7 b	6.2 b	6.6	5.7 a	4.9 b	5.0 b	5.2 b
c) Early autumn +	7.0 a	6.3 c	5.9 c	6.4	5.7 a	4.5 c	4.8 c	5.0 c
P-value	<0.0001	<0.0001	0.0006	>0.10	0.031	<0.0001	<0.0001	<0.0001

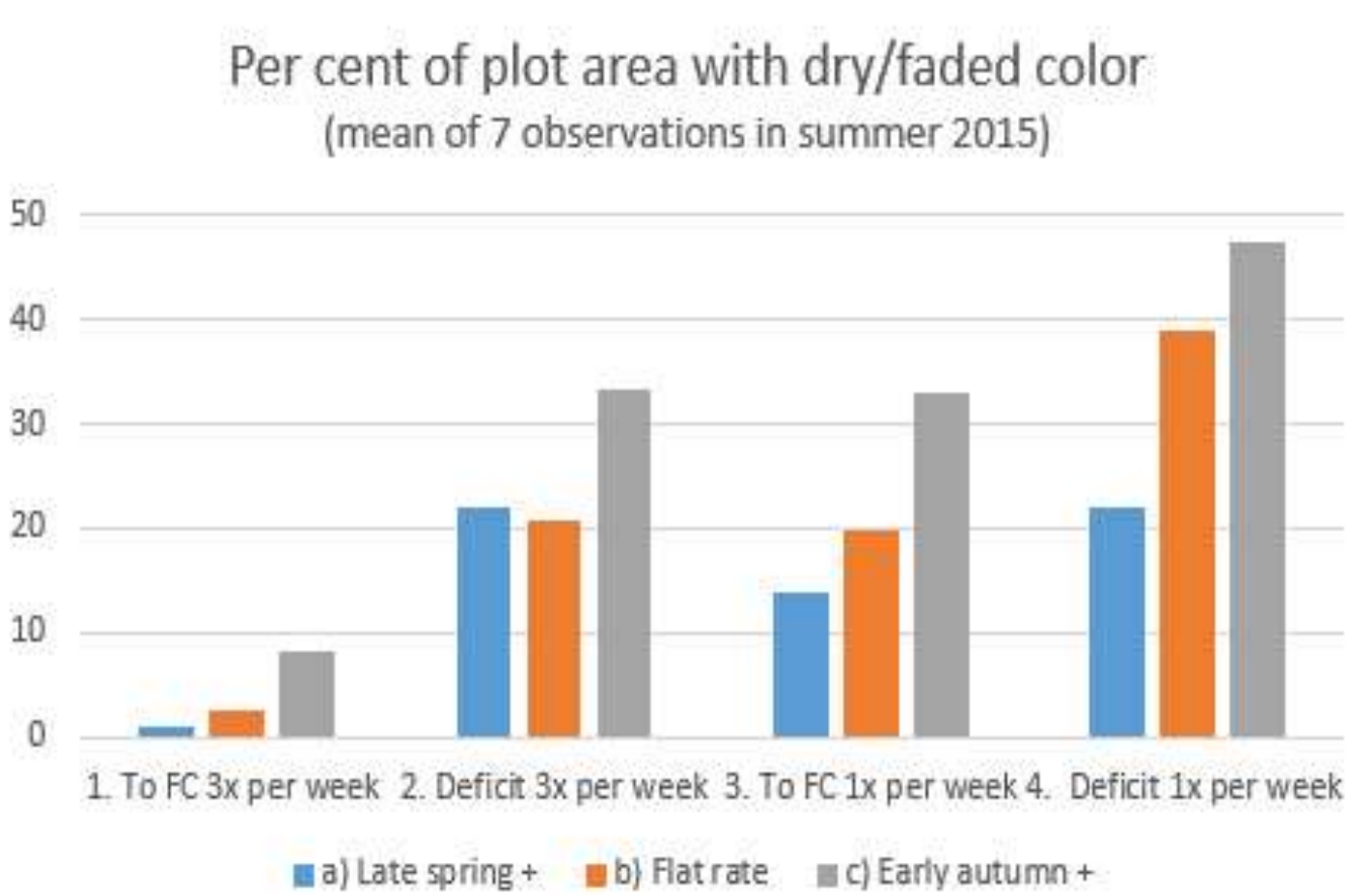
Turf quality appearance on subplots

(Observation on 11-08-2015)

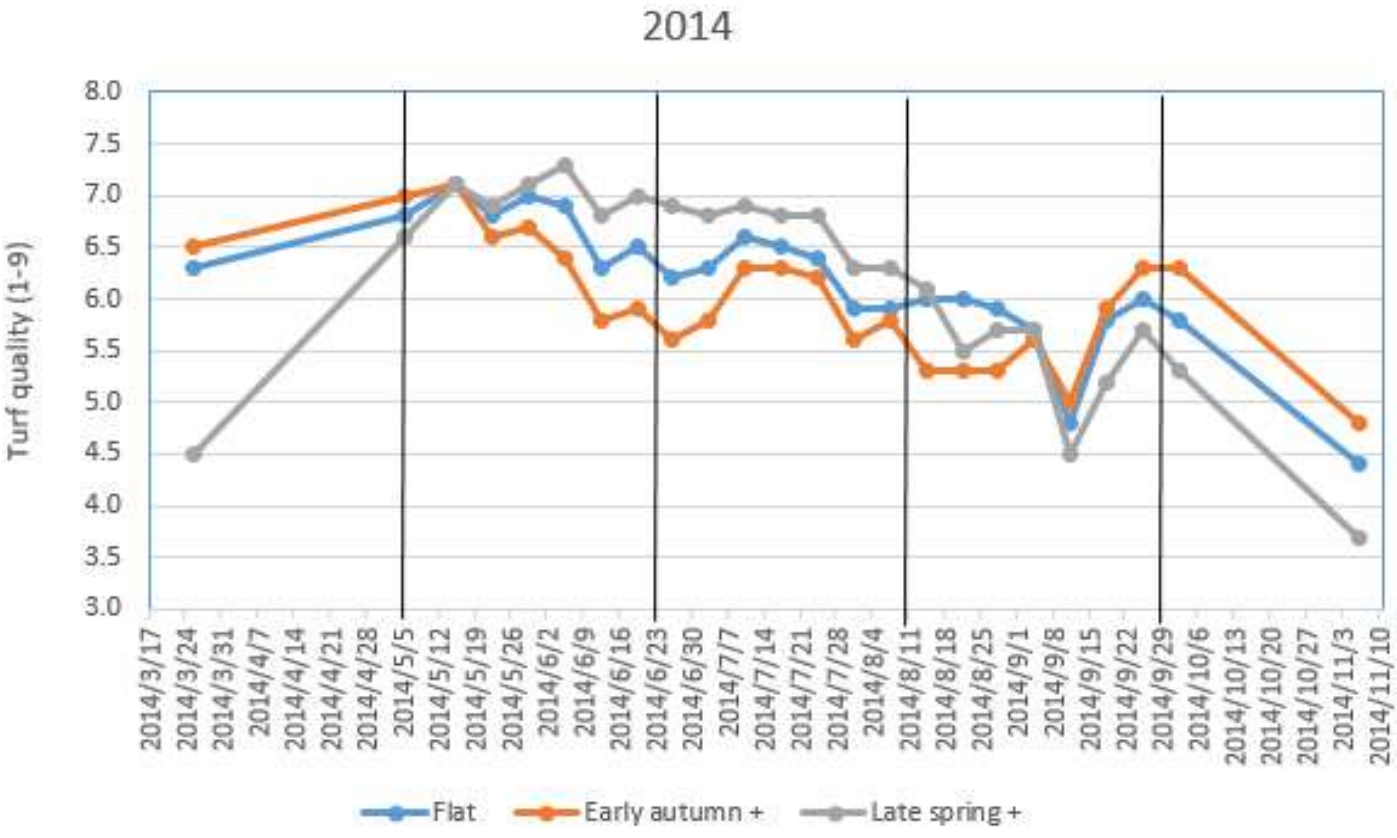
	FC 3X	DEF 3X	FC 1X	DEF 1X
Late spring+				
Flat rate				
Early autumn+				

The Driest Plots in Irrigation Treatment No.4 (Observation on 11 Aug. 2015)

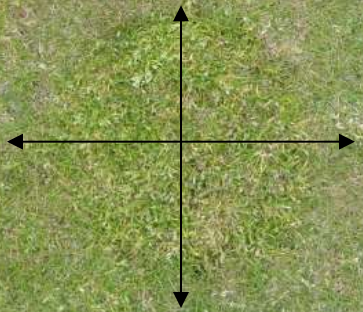
	Late spring+	Flat rate	Early autumn+
DEF 1			


Per cent of plot area with dry/faded color
(mean of 7 observations in summer 2015)
50
40
30
20
10
0
1. To FC 3x per week
2. Deficit 3x per week
3. To FC 1x per week
4. Deficit 1x per week
a) Late spring +
b) Flat rate
c) Early autumn +

Fertilizer distribution effect on turf quality in 2014

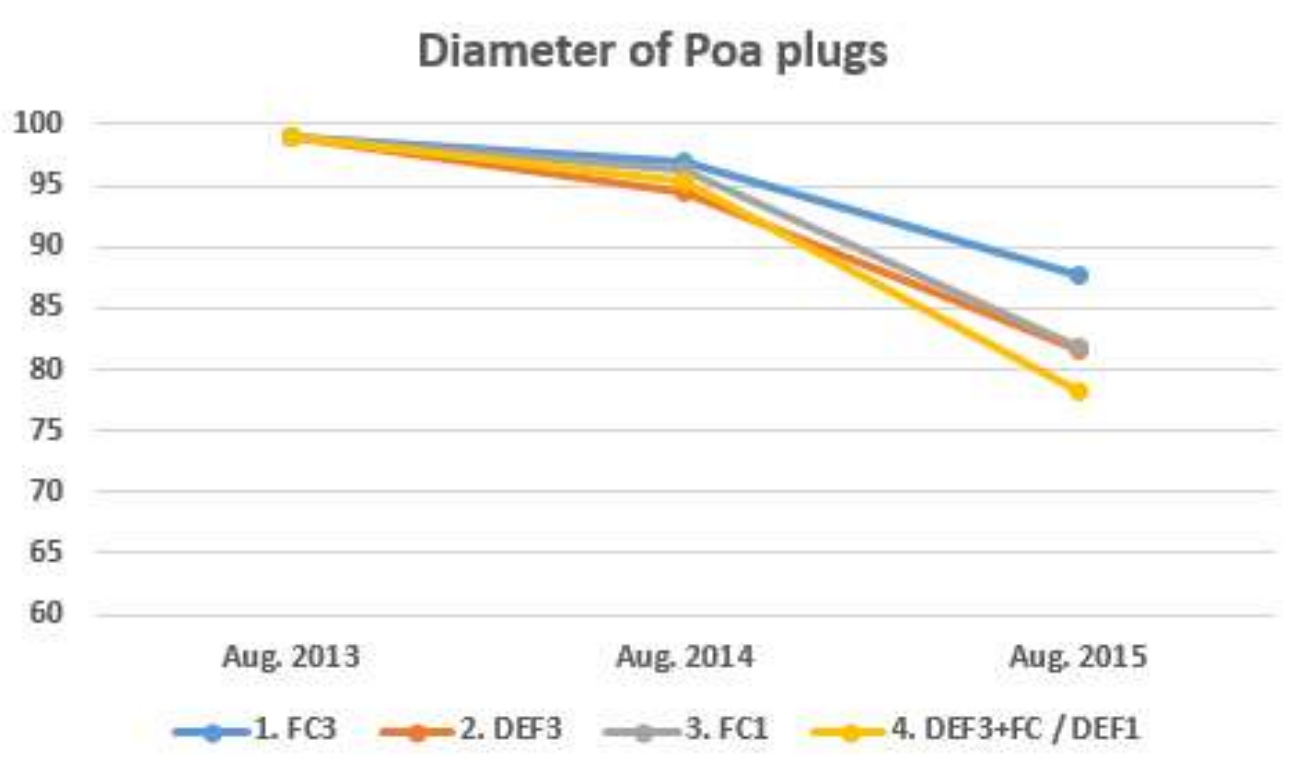


Competition from *Poa annua* was measured by regular assessment of coverage



…and by measuring increase or decrease in diameter of 99 mm wide *Poa annua* plugs inserted into the red fescue at the start of the trial

Different irrigation effect on *Poa* plug



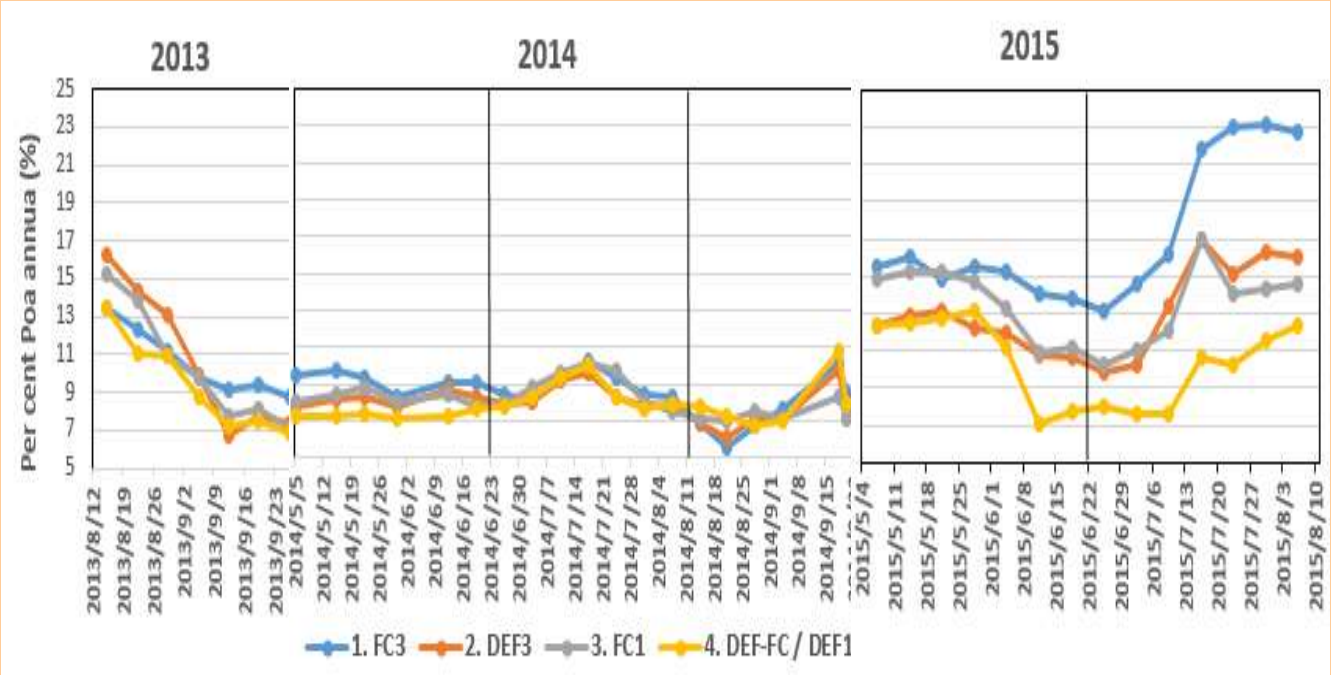
Poa plug appearance on subplots (Observation on 11-06-2015)

	FC 3X	DEF 3X	FC 1X	DEF 1X
Late spring+				
Flat rate				
Early autumn+				

Poa annua, % of plot area, mean values

	Aug. 2013 -Aug. 2014	Aug. 2014 -Aug. 2015
Main effect irrigation		
1. To FC 3x per week	10.5	14.4 a
2. Deficit 3x per week	10.3	11.5 ab
3. To FC 1x per week	10.3	11.6 ab
4. Deficit 3x per wk + to FC every 2 weeks / Deficit 1x per week	9.5	9.7 b
P-value	ns	0.06
Main effect fertilizer distribution		
a) Late spring +	10.6	10.3 a
b) Flat rate	10	12.1 a
c) Early autumn +	9.9	13.5 b
P-value	ns	<0.0001

Poa annua, % of plot area during the course of the experiment

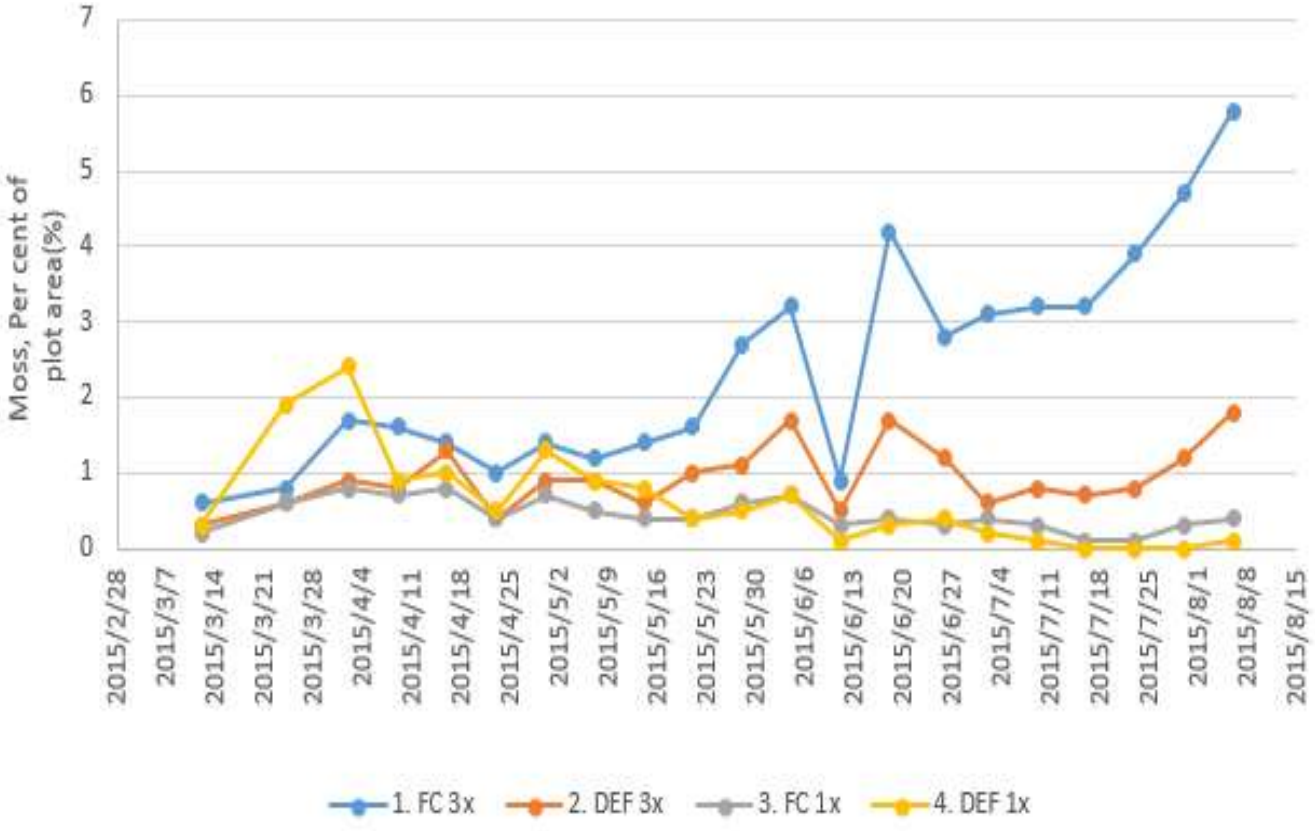


Moss in subplots

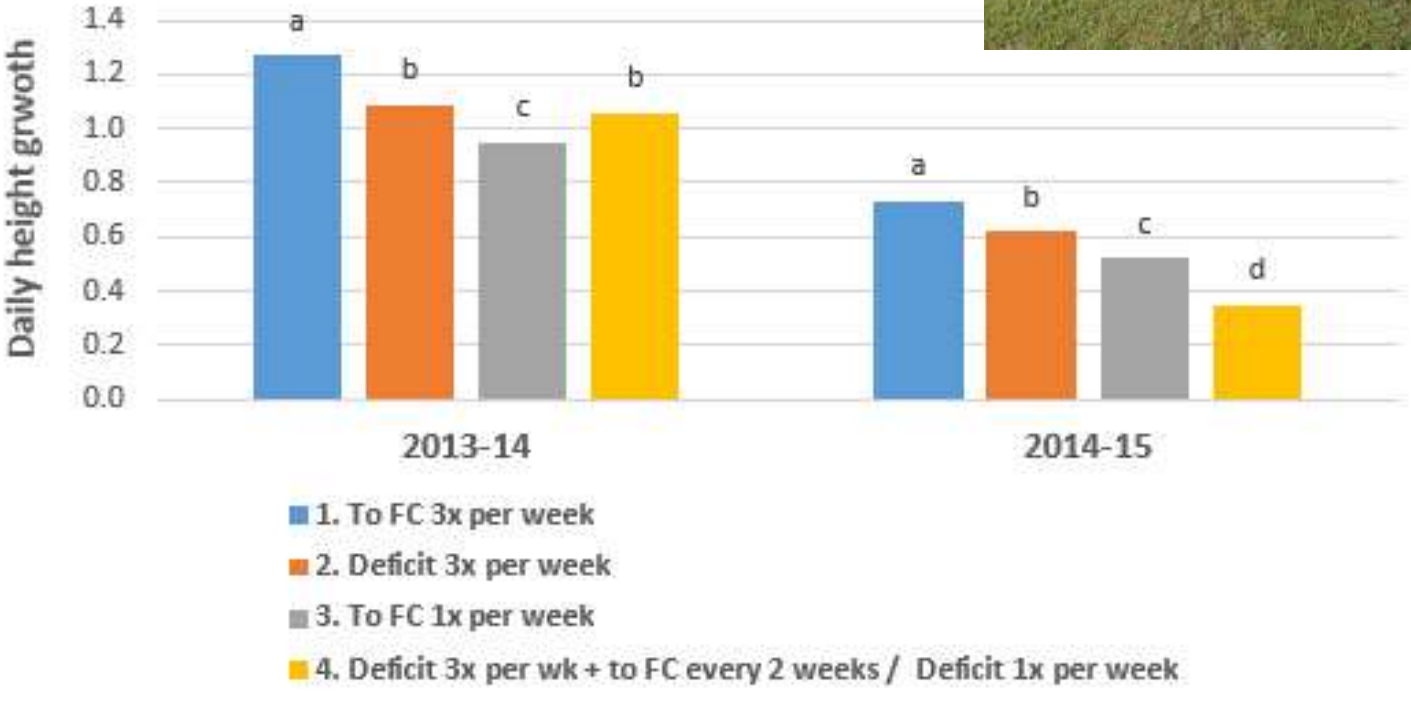
(Observation on 12-08-2015)

	Late spring+	Flat rate	Early autumn+
FC 3X			

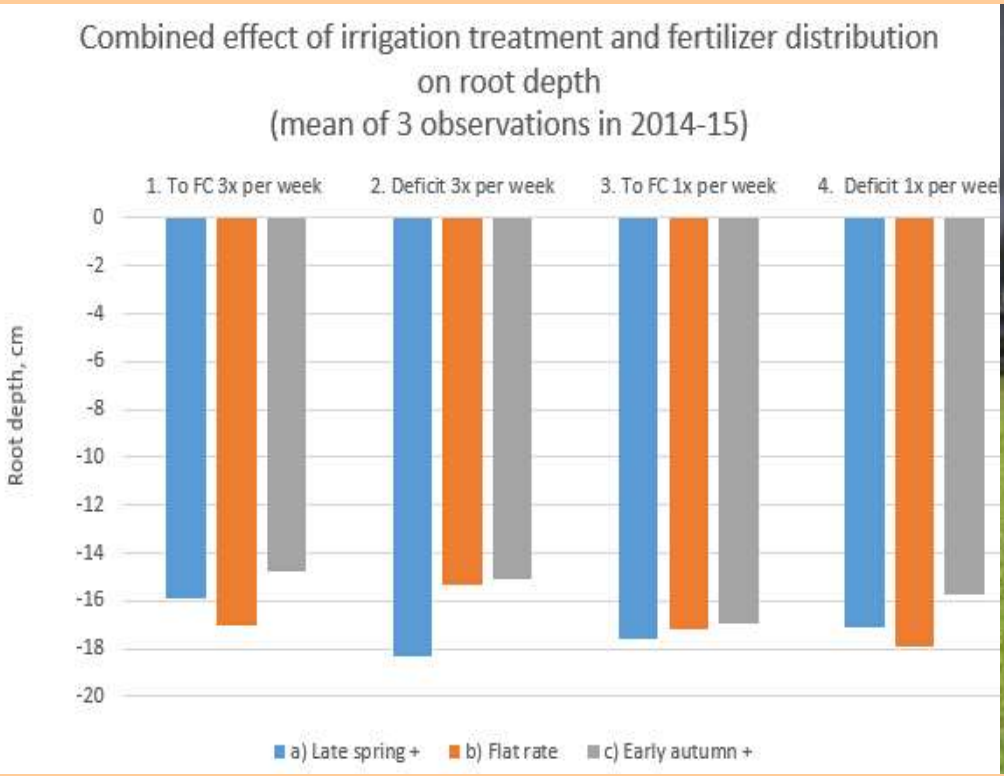
Effect of irrigation treatment on moss development, 2015



Daily height growth (mm)

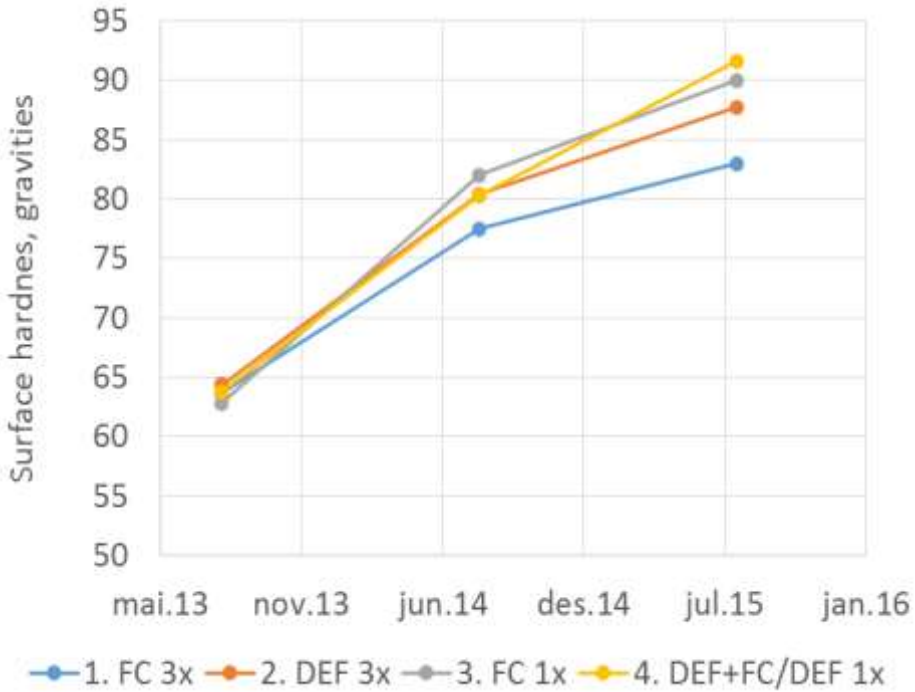


Root depth (cm)



SURFACE HARDNESS

(CLEGG HAMMER, 2.25 KG)



CONCLUSIONS I:

COMPARISON OF IRRIGATION TREATMENTS

1. On average for two years, deficit irrigation to 60 % of FC 3x resulted in 45 % less water consumption than deep and infrequent irrigation 1x per week and 72 % less water consumption than irrigation to FC 3x per week.

2. The visual turf quality was the same with deficit irrigation 3x per week and with irrigation to FC 1x per week, but irrigation to FC 1x per week tended to result in less height growth and firmer greens.

-

3. Red fesuce did not develop distinct dry patches in the same way as in former trials with creeping bentgrass, but in the last experiemental year, soil water contents down to 5 % resulted in large areas with light color and less growth. This did not happen in the first experimental year, presumably due to the treatment with soil surfactant in that year.

4. There was a tendency for irrigation to FC 1x per week to result in less *Poa annua* than deficit irrigation 3x per week, but the difference was not significant. *Poa annua* invasion was low during the warm summer 2014, but increased significantly due to mild temperatures and much rain in Oct./ Nov. 2014 and a chilly summer in 2015.

5. Invasion of moss during the summer 2015 was influenced both by irrigation quantity and irrigation frequency. Moss was no problem if the green was irrigated only once per week.

CONCLUSIONS II:

COMPARISON OF SEASONAL FERTILIZER DISTRIBUTIONS

1. The 'Late spring +' fertilization treatment (= enhanced fertilization from early May to late June) resulted in significantly

- better visual turf quality
- less competition from *Poa annua*
- less moss
- deeper roots

than the 'Early autumn +' fertilization treatment (=enhanced fertilization from mid August to 1 Oct.).

2. ‘Flate rate’ from early May to 1 Oct. was between the two other treatments, but not significantly different from ‘Late spring +’ for most characters.

3. ‘Early autumn +’ fertilization resulted in faster greenup and higher clipping yields in April, but the response time for enhanced fertilization was much shorter in spring than in autumn.

4. ‘Early autumn+’ fertilization cannot be recommended for fescue greens in northern Europe.

谢谢!
Thank you!
Tusen takk!
Gracias!
Tak!
Tack!
Go raibh maith agat!
Merci!
Dankjewel!
Danke!