



NIBIO

NORSK INSTITUTT FOR
BIOØKONOMI

Effect of rolling on *Microdochium* patch

Field trial at Copenhagen Golf Club 2020-21

NIBIO REPORT | VOL. 8 | NO. 109 | 2022



Hesselsøe, K.J., Nilsson, M., Kvalbein, A. og Espevig, T.
Divisjon for miljø og naturressurser

TITTEL/TITLE

Effect of rolling on Microdochium patch – field trial at Copenhagen Golf Club 2020-21

FORFATTER(E)/AUTHOR(S)

Hesselsøe, K. J., Nilsson, M., Kvalbein, A. and Espevig, T.

DATO/DATE:	RAPPORT NR./ REPORT NO.:	TILGJENGELIGHET/AVAILABILITY:	PROSJEKTNR./PROJECT NO.:	SAKSNR./ARCHIVE NO.:
09.08.2022	8/109/2022	Open	51490-13	22/01018
ISBN:	ISSN:	ANTALL SIDER/ NO. OF PAGES:	ANTALL VEDLEGG/ NO. OF APPENDICES:	
978-82-17-03127-7	2464-1162	19	0	

OPPDRAAGSGIVER/EMPLOYER:

The Danish Environmental Protection Agency
and STERF

KONTAKTPERSON/CONTACT PERSON:

Karin Juul Hesselsøe

STIKKORD/KEYWORDS:

Stikkord norske

Microdochium, snømugg, mekanisk, golfgreen,
rulling.

Keywords

Microdochium patch, mechanical, golf, green,
rolling

FAGOMRÅDE/FIELD OF WORK:

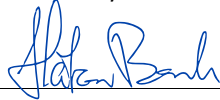
Grøntanlegg og vegetasjonsøkologi

Urban Greening and Vegetation Ecology

SAMMENDRAG/SUMMARY:

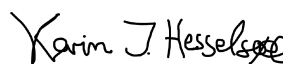
I feltforsøk med lett rulling av en rødsvingeldominert golfgreen ved Københavns golfklubb i 2020 og 2021 ble effekten på Microdochiumflekk studert. Greenen ble rullet to eller fire ganger i uka i tre eller fem måneder fram til november hvert år. Det var ikke noe soppangrep i 2021, men resultatene fra 2020 viste at rulling hadde statistisk sikker effekt og reduserte mikrodochiumflekk fra 5% på ubehandlet til 2,0 og 2,3 % der det var rullet henholdsvis to eller fire ganger i uka. Grønnfarge og visuelt helhetsinntrykk ble også påvirket av rulling. Helhetsinntrykket ble forbedret av rulling. Grønnfargen om høsten var best for ubehandlede ruter i 2020, men det var ingen forskjeller i 2021. Forsøket antyder at lett rulling to ganger i uka fra august til november kan redusere angrep av mikrodochiumflekk på rødsvingeldominerte greener i Skandinavia.

GODKJENT /APPROVED



HÅKON BORCH

PROSJEKTLEDER /PROJECT LEADER



KARIN JUUL HESSELSØE



NIBIO

NORSK INSTITUTT FOR
BIOØKONOMI

Preface

The R&D project 'IPM-GOLF: Integrated management of important turfgrass diseases and insect pests on European golf courses' was initiated by Norwegian Institute for Bioeconomy Research (NIBIO) and Scandinavian Turfgrass and Environment Research Foundation (STERF) in 2019. The project has several work packages investigating alternative methods to prevent turfgrass diseases of which the sub project (WP 1.3) investigated the effect of rolling to prevent *Microdochium* patch. WP 1.3 received funding from STERF and The Danish Environmental Protection Agency (Miljøstyrelsen) in January 2020. This report comprises results from field trials at Copenhagen Golf Club in 2020-21.

Landvik, 09.08.22

Karin Juul Hesselsøe

Content

- 1 Introduction..... 6
- 2 Materials and methods 7
 - 2.1 Experimental site.....7
 - 2.2 Experiment design7
 - 2.3 Weather data.....8
 - 2.4 Maintenance practice.....9
 - 2.5 Data collection.....9
 - 2.6 Statistical analyses.....9
- 3 Results..... 10
 - 3.1 Microdochium patch and turfgrass visual quality10
 - 3.2 Colour11
 - 3.3 Soil volume water content13
 - 3.4 Coverage of annual bluegrass.....14
- 4 Discussion 15
 - 4.1 Microdochium patch and turfgrass visual quality15
 - 4.2 Soil volume water content and coverage of annual bluegrass.....16
- 5 Conclusion 17

Summary

Field experiments on a red fescue dominated golf green at Copenhagen Golf Course in 2020 and 2021 examined the effects of light weight rolling on development of *Microdochium* patch, caused by *Microdochium nivale*. The green was rolled two or four times per week in either three or five months ending in November. *Microdochium* patch did not develop in 2021, but results from 2020 showed that rolling had a significant impact and reduced patches from 5 % at the unrolled plots to 2.0 % and 2.3 % on plots rolled two or four times per week.

Green colour and overall turfgrass impression were also affected by rolling. The visual quality was improved by rolling. The colour in the autumn was best at the unrolled plots in 2020, but there were no differences in 2021.

The experiment indicates that light weight rolling two times per week from August to November can reduce negative impact from *Microdochium nivale* on red fescue dominated golf greens in Scandinavia.

1 Introduction

Microdochium patch, caused by the fungus *Microdochium nivale*, is the economically most important disease on turfgrass in the Nordic countries (Melbye, 2019; Kvalbein et al., 2017). The use of fungicides in Europe is strongly restricted, and there is a need for alternatives to prevent this fungal disease.

Rolling with light-weight greens rollers as a part of weekly golf green maintenance is reported to influence fungal diseases on turfgrass. Inguagiato et al. (2009) showed that rolling reduced antracnose (*Colletotrichum cereale*) on annual bluegrass (*Poa annua*) greens and Giordano et al. (2012) observed that greens rolling on a mixed stand of annual bluegrass and creeping bentgrass (*Agrostis stolonifera*) five times per week reduced dollar spot incidence 50 %. In STERF's Dollar spot-project, Espevig et al. (2020) found that on a red fescue green rolling two and four times per week reduced dollar spot patches by 61% and 95%, respectively. They concluded that rolling 3-4 times per week can be recommended on Scandinavian golf greens that are under pressure from the Scandinavian varieties of dollar spot (*Clarireedia* spp).

The influence of rolling on Microdochium patch (*Microdochium nivale*) was studied by Mattox et al. (2018). They found that rolling five times per week was effectively inhibiting Microdochium patch by 47 and 75 %.

The objective of this field experiment was to investigate the effect of rolling on the development of Microdochium patch on a mixed fescue/bentgrass (*Festuca rubra/Agrostis capillaris*) green at Copenhagen Golf Club.

2 Materials and methods

2.1 Experimental site

The experiment was conducted at Copenhagen Golf Club, Denmark on a well-established push-up green. The top 7-8 cm of the profile consisted of sand/compost root zone mixture 'Greenmix' delivered from 'Solum Group'. Soil pH at the start of the experiment was 6.8.

The green had been established with a mixture of red fescue (*Festuca rubra*) and colonial bentgrass (*Agrostis capillaris*). The present sward composition was not determined, but the maintenance strategy has for many years aimed for increased red fescue dominance.

2.2 Experiment design



Photo 1: The trial at Copenhagen Golf Club, December 2020. Blue: Rolled four times per week, yellow: No rolling, red: Rolled two times per week. T1=rolling from June to Nov to the right of the middle line and T2=rolling from Aug to Nov to the left of the middle line. Photo: Martin Nilsson.

The experimental variables were:

- A. Rolling period
 - a. June to November (five months)
 - b. August to November (three months)
- B. Rolling frequency
 - a. Two times per week (Tuesday, Friday) (T1)
 - b. Four times per week (Tuesday – Friday) (T2)

The experiment design was a split block design with three repetitions. Plots were 6 m². The experiment started in June 2020 and continued until March 2022. Each rolling was done by passing over the treatment plot two times – first back and then forth.

In 2020 rolling was done with a Smithco Tournament Ultra 7590 greens roller (Photo 2). In 2021 the previous Smithco greens roller was replaced with a Smithco Tournament Ultra XXL (Photo 3). Technical specifications for the two greens rollers are presented in Table 1.

Table 1: Technical specifications for the two greens rollers used in the experiment.

Greens roller type	Number of rollers	Length of rollers	Diameter of rollers	Total length cm			Weight kg
				Total length	Total width	Total height	
Smithco Tournament Ultra 7590	2	91	20.32	111	114	124	378
Smithco Tournament Ultra XXL	3	2 x 48 1 x 91	2 x 20 1 x 8	122	185	119	407



Photo 2: Rolling with Smithco Tournament Ultra 7590 in 2020 (to the left). Photo: Karin J. Hesselsøe.

Photo 3: Rolling with Smithco Tournament Ultra XXL in 2021 (to the right). Photo: Martin Nilsson.

2.3 Weather data

Monthly air temperature and precipitation was collected from the nearest weather station: Lyngby-Taarbæk in 2020 and 2021 and compared with the average for Denmark (1991-2020). Data is shown in Table 2 (DMI, 2022).

The weather conditions were favourable for grass growth in the experimental period. 2020 was a dry season with approx. 100 mm less precipitation than 2021.

Table 2: Monthly air temperature and precipitation in 2020-21 from the nearest weather station (Lyngby-Taarbæk).

Month	Mean monthly temperature °C			Monthly precipitation mm		
	2020	2021	1991 – 2020	2020	2021	1991 – 2020
Jan.	5.1	0.7	1.6	71	69	65
Feb.	4.7	0.2	1.5	97	27	50
Mar.	4.6	4.2	3.3	22	43	46
Apr.	8.2	6.3	7.2	21	22	39
May	10.8	11.0	11.4	35	82	47
Jun.	17.4	17.7	14.5	62	19	64
Jul.	15.8	19.6	16.9	58	74	66
Aug.	19.0	16.2	16.9	43	121	82
Sep.	14.7	14.9	13.6	56	68	75
Oct.	10.7	10.8	9.4	72	82	83
Nov.	7.8	7.0	5.5	25	43	70
Dec.	4.4	2.1	2.8	65	83	71
Mean / sum	10.3	9.2	8.7	626	730	759

2.4 Maintenance practice

Maintenance of the experiment green followed the same procedures as the other greens on the course. No fungicides were applied during the experiment.

The green received: 50-0-0 N-P-K kg/ha/year, applied in three applications, mowing height was 4.2 mm all season, topdressing with pure sand was applied three times per year. Other mechanical treatments were one deep aeration (Vertidrain) and one aeration with solid tines.

The irrigation was based on the principles of deficit irrigation.

2.5 Data collection

Start assessments of each treatment plot were made in June 2020 and 2021 just before first experiment treatment. The following characters were recorded by course manager Martin Nilsson every four weeks from June to Nov/Dec in 2020 and 2021:

Turfgrass visual quality on a scale from 1 to 9 where 9 is the best turf and 5 is the lowest acceptable turf. Turfgrass quality is an overall score for live turf cover, uniformity, greenness, leaf fineness, disease resistance, freedom of weeds and grass shoot density.

Turfgrass colour (greenness) was recorded visually on a scale from 1-9 where 1-very light, 3-light, 5-medium, 7-dark and 9- very dark green). It is assessed on unstressed and non-diseased turf.

Coverage of Microdochium patch was recorded visually as percent of plot area with diseased turf.

Soil volume water content (% VWC) was recorded in 0-7.5 cm depth with a FieldScout TDR 350 (Time Domain Reflectometry) instrument from Spectrum Technologies. Three recordings were done per plot.

In March 2022 **Coverage of annual bluegrass (*Poa annua*)** as percent of plot area was recorded at the end of the experiment by a group of greenkeeper students under supervision from the project manager.

2.6 Statistical analyses

All data was collated and analysed statistically using ANOVA mixed effects model.

3 Results

3.1 Microdochium patch and turfgrass visual quality

2020:

In the first year *Microdochium* patches did not appear until the beginning of December.

Rolling two and four times per week caused significantly less *Microdochium* patch in December compared to no rolling (Table 3).

At the beginning of the trial in June there was no difference between turfgrass visual quality, but in August, September and October rolling improved the overall impression significantly compared to no rolling. In November and December turfgrass visual quality decreased in all plots, but rolling was still significantly better than no rolling.

Rolling four times per week did not improve turfgrass visual quality compared to two times per week. Neither did it affect the *Microdochium* patches significantly. In November and December plots rolled four times per week had insignificantly lower turfgrass visual quality than plots rolled two times per week.

Timing of rolling (June-December compared to August-December) did not affect neither attacks from *Microdochium* patch nor turfgrass visual quality (data not shown).

Table 3: Turfgrass visual quality and % *Microdochium* patch on plots rolled two and four times per week compared to no rolling in 2020. Figures with different letters are statistically different on a 0.001 probability level, ns - not statistically different.

2020	Turfgrass visual quality Scale 1-9			Microdochium patch %
	June	Aug-Oct	Nov-Dec	December
Rolling two times per wk	5.0	7.0 a	6.5 a	2.0 a
Rolling four times per wk	5.0	7.0 a	6.0 a	2.3 a
No rolling	5.0	5.0 b	4.0 b	5.0 b
P-value	ns	0.004	0.004	0.003



Photo 4: Weather conditions in autumn 2021 at the experimental green were very mild and no signs of diseases were seen. Beginning of November 2021. Photo: Martin Nilsson.

2021:

The weather conditions in late summer and autumn were mild (Table 2 and Photo 4), and no attacks from *Microdochium nivale* were observed at the experimental green. At the golf course generally only few and insignificant signs of *Microdochium* patch were found. From the beginning of December snow covered the area, and no recordings were made in December. In Jan-March 2022 the green was frozen, and no changes in disease cover were observed.

Table 4: Turfgrass visual quality on plots rolled two and four times per week compared to no rolling in 2021. Figures with different letters are statistically different on a 0.001 probability level, ns - not statistically different.

2021	Turfgrass visual quality Scale 1-9		
	June-Aug	September	Oct-Nov
Rolling two times per wk	5.0	6.0	7.0 a
Rolling four times per wk	5.0	6.0	7.0 a
No rolling	5.0	6.0	6.0 b
P-value	ns	ns	0.001

Recordings of turfgrass visual quality showed no difference between rolling/no rolling from June to September, but in October and November rolled plots were significantly better. No difference was found between rolling two and four times per week, and no difference between rolling from June to November and from August to November (data not shown).

3.2 Colour

Visual assessments of colour were done in 2020 and 2021. In 2020 the recordings were 3 (light green) in June and 5 (medium green) in July-September. The experiment treatments did not cause any differences in that period (Table 5). In October plots with no rolling were significantly darker green (7)

compared to plots that were rolled which were medium green (5). In November and December, this difference still appeared as the unrolled plots were greener than the rolled plots, and plots rolled four times per week had lighter colour (3) than plots rolled two times (5), but this difference was not significant.

In 2021 no differences in colour were found between the treatments. Colour improved in all treatments from 5 in June to 7 in October and November (data not shown).

Table 5: Colour in plots rolled two and four times per week compared to no rolling in 2020. Figures with different letters are statistically different on a 0.001 probability level, ns - not statistically different.

2020	Color			
	Scale 1-9			
	June	July-Sep	October	Nov-Dec
Rolling two times per wk	3.0	5.0	5.0 b	5.0 b
Rolling four times per wk	3.0	5.0	5.0 b	3.0 b
No rolling	3.0	5.0	7.0 a	7.0 a
P-value	ns	ns	0.001	0.001

3.3 Soil volume water content

In 2020 soil volume water content (%VWC) were between 20 and 23 %. No differences between the treatments were found.

Table 6: Soil volume water content in plots rolled two and four times per week compared to no rolling in 2020. ns - not statistically different.

2020	Soil moisture %			
	June	July	August	September
Rolling two times per wk	21.3	20.2	21.7	22.8
Rolling four times per wk	21.0	20.0	23.2	22.5
No rolling	21.7	20.7	22.2	22.3
P-value	ns	ns	ns	ns

In 2021 %VWC varied between 16 and 19.5 %. In July, August and September rolling two times per week gave significantly higher %VWC than rolling four times per week. The water content in the unrolled plots was intermediate, but not statistically different from the treated plots in July and August. In September plots with no rolling was significantly more moist than plots rolled four times per week.

Table 7: Soil volume water content in plots rolled two and four times per week compared to no rolling in 2021. Figures with different letters are statistically different on a 0.001 or 0.01 probability level, ns - not statistically different.

2021	Soil moisture %				
	May	June	July	August	September
Rolling two times per wk	17.8	19.5	17.4 a	18.7 a	17.8 a
Rolling four times per wk	16.8	19.0	16.3 b	17.4 b	16.2 b
No rolling	17.0	19.2	17.1 ab	17.9 ab	17.3 a
P-value	ns	ns	0.040	0.040	0.001

3.4 Coverage of annual bluegrass

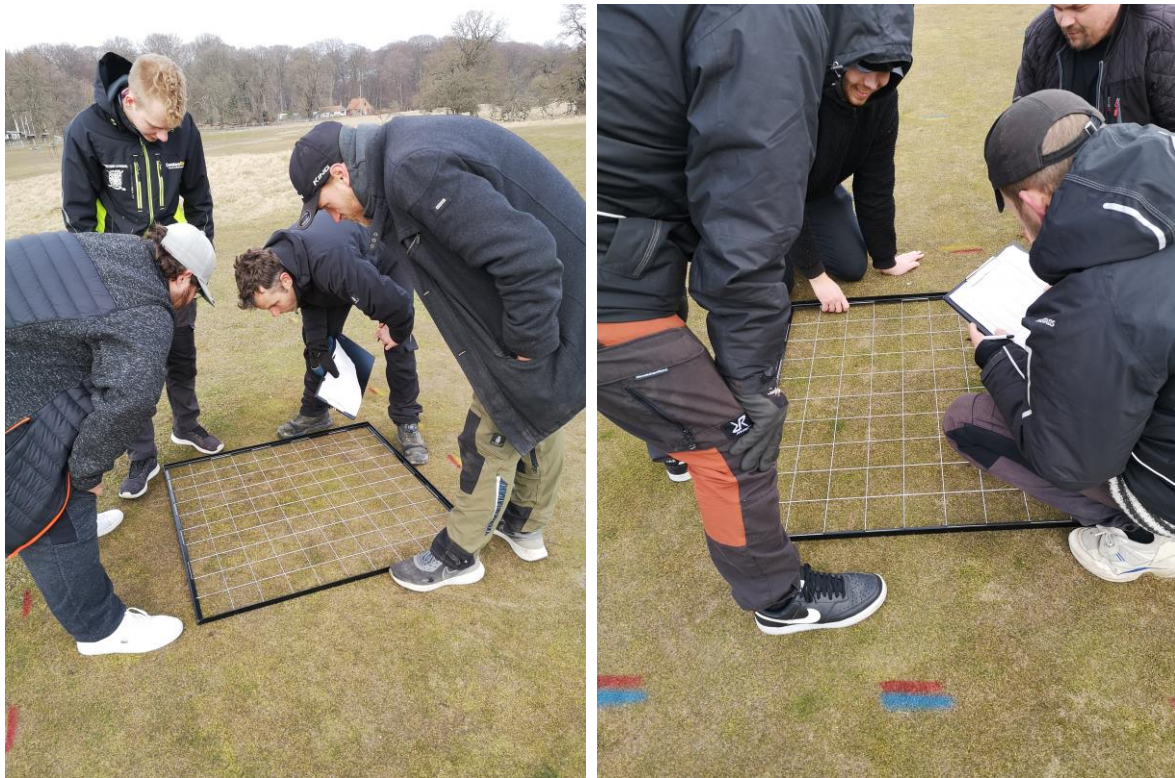


Photo 5: A group of greenkeeper students visiting the experimental green in March 2022 evaluated coverage of annual bluegrass. Photo: Karin J. Hesselsoe.

Coverage of annual bluegrass was recorded on 10 March 2022. Encroachment of annual bluegrass varied from 1-1.5 %, and no differences were found between the treatments.

Table 8: Coverage of annual bluegrass measured in March 2022 in plots rolled two and four times per week compared to no rolling. ns - not statistically different.

March 2022	Coverage of annual bluegrass %
Rolling two times per wk	1.5
Rolling four times per wk	1.4
No rolling	1.1
P-value	ns

4 Discussion

4.1 Microdochium patch and turfgrass visual quality



Photo 6: The trial in December 2020. From left: Yellow: No rolling, blue: Rolled four times per week, red: Rolled two times per week. Photo: Martin Nilsson.

Results from 2020 showed that rolling two times and four times per week caused significantly lower attacks of *Microdochium* patch in December compared no rolling (Table 3). These differences were not confirmed in 2021 as there were no disease that year on the experimental green.

Regarding turfgrass visual quality in 2020 (Table 3) there was no difference in the beginning of the trial in June, but from August rolling improved turfgrass visual quality significantly compared to no rolling through the autumn until December. The higher score was mainly due to less moss and lower attacks from *Microdochium* patch (Martin Nilsson, pers. comm.). In December 2020 plots with no rolling were greener than plots with rolling (Photo 6). Observations of darker green colour in plots with no rolling in late autumn 2020 (Table 5) confirmed this.

According to the golf course manager, Martin Nilsson, the differences could be explained by more moss, but other rationales could be discussed. There is a well-recognized relationship between colour and nitrogen status of grass plants (Bell et al, 2004). The significantly reduced colour from rolling could be explained by different nitrogen levels in the leaf tissue. We have not found reported that rolling reduces air porosity in green rootzones, but both Giordano et al. (2012) and Mattox et al. (2018) showed that soil moisture content was higher with rolling. Compaction could increase the numbers of anaerobic microsites in the soil, and anoxia will increase denitrification from the soil

(Horgan et al, 2002) and reduce the nitrogen availability for the plants. It is also likely that rolling for the same reasons could reduce thatch decomposition and hence the nitrogen availability.

Rolling four times per week did not improve the turfgrass visual quality compared to two times per week. In November and December plots rolled four times per week had slightly lower turfgrass visual quality than plots rolled two times per week. Plots rolled two times per week looked slightly less 'worn' (Martin Nilsson, pers. comm).

In the study of Mattox et al. (2012) the practice of rolling five times per week throughout the winter period on sand-based annual bluegrass putting greens did not cause observable injury to the turfgrass plants, but we should keep in mind the different N-levels and the growth pattern of the grass species. Annual bluegrass is less winter dormant than red fescue, and the nitrogen fertilization rate at Copenhagen Golf Club was extremely low. Lower wear tolerance was therefore to be expected.

Results from 2021 on turfgrass visual quality (Table 4) showed no differences until October where rolled plots were slightly better. Weather conditions in the autumn were very favourable, and no wear from the green's roller was observed not even in the plots rolled four times per week in November. This can be due to the weather conditions and the fact that a new and wider greens roller with power steering was used in the 2021-season, which apparently made less wear to the turfgrass compared to the green's roller used in 2020. Observations from rolling on the whole course confirmed this (Martin Nilsson, pers. comm). Observations of colour in 2021 did not show any differences between the treatments which also could be explained by different weather and use of the new roller.

4.2 Soil volume water content and coverage of annual bluegrass

No differences in soil water volume water content were found in 2020. In 2021 rolling twice pr week was approx. 1 % higher than rolling 4 times pr week in July, Aug, and Sep while no rolling was in between. Both Giordano et al. (2012) and Mattox et al. (2018) showed that soil moisture content was higher with rolling, and their observations suggested that rolling may be contributing to greater water holding capacity in the upper root zone of the turfgrass canopy. The results from Copenhagen Golf Club in 2020-21 are in conflict to these findings and could be due to an artefact as the experiment was placed on a slope with higher water soil content in one end of the treatment plots. Measurements in the single plots across the slope showed no differences between treatments (Martin Nilsson, pers. comm.).

No significant differences in the coverage of annual bluegrass were found between the treatments which suggests that rolling two or four times per week has no influence on the coverage of annual bluegrass.

5 Conclusion

First year's results showed that rolling two or four times per week improved turfgrass quality through the growing season, and that significant reductions of *Microdochium* patch was achieved by rolling from August to November. These results could not be confirmed in the second year of the experiment, because the disease incidence was very low and no *Microdochium* patch was observed.

Observations of colour in 2020 showed a darker green colour in plots that were not rolled. This could not be confirmed in the second year.

Recordings of coverage of annual bluegrass at the end of the experiment showed no effect of rolling on the encroachment of annual bluegrass.

Espevig et al. (2020) recommended rolling 3-4 times per week on Scandinavian golf greens that are under dollar spot pressure. This experiment supports this recommendation and suggests that rolling two times per week from August to November is sufficient to reduce *Microdochium* patch on Scandinavian red fescue dominated golf greens.

References

- Bell, G. E., B.M. Howell, G.W Johnson, W.R. Raun, J.B. Solie, M.L. Stone (2004): Optical sensing of Turfgrass Chlorophyll Content and Tissue Nitrogen. Hort. Sc. 39(5): 1130-1132
- DMI (2022): <https://www.dmi.dk/vejrkarkiv/>
- Espevig, T., K. Normann, N. Bosholdt, M.Usoltseva, S. Nilsson, A. Olofsson, J.A. Crouch, K. Entwistle, K. Sundsdal, T.O. Pettersen, T.S. Aamlid and T. Torp (2020): Risk assessment, management and control of dollar spot caused by *Clariireedia* species on Scandinavian golf courses (2017-2020). STERF Final Report. http://www.sterf.org/Media/Get/3604/final-report-dollar-spot_final-report_2020
- Giordano, P. R., Nikolai, T. R., Hammerschmidt, R. and Vargas Jr., J. M. (2012): Timing and frequency effects of lightweight rolling on dollar spot disease in creeping bentgrass putting greens. Crop Science 52:1371-1378.
- Horgan, B.P., B.E. Branham, R.L.Mulvaney (2002): Direct Measurement of Denitrification Using ¹⁵N-labelled Fertilizer Applied to Turfgrass. Crop Sci Vol 42, Issue 5, pp 1602-1610
- Inguagiato, J. C., Murphy, J. A. and Clarke, B. B. (2009): Anthracnose disease and annual bluegrass putting green performance affected by mowing practices and lightweight rolling. Crop Science 49: 1454–1462.
- Kvalbein A., W.M. Marie Waalen, L. Bjørnstad, T.S. Aamlid and T. Espevig. 2017. Winter injuries on golf greens in the Nordic countries: Survey of causes and economic consequences. Int. Turfgrass Soc. Res. J. 13:604-609.
- Mattox, C.M., A.R. Kowalewski, B.W. McDonald, J.G. Lambrinos, and J. Pscheidt. 2018. Rolling and biological control products affect *Microdochium* patch severity on a sand-based annual bluegrass putting green. J. Agron. 110:2124–2129. doi:10.2134/agronj2018.01.0008
- Melbye P. 2019. STERF survey on prioritizing research arears, 2019. <https://www.survey-xact.dk/report/shared/e8b4947e-fed6-42b8-9705-7b2946efae7d>

NIBIO - Norwegian Institute of Bioeconomy Research was established July 1 2015 as a merger between the Norwegian Institute for Agricultural and Environmental Research, the Norwegian Agricultural Economics Research Institute and Norwegian Forest and Landscape Institute.

The basis of bioeconomics is the utilisation and management of fresh photosynthesis, rather than a fossile economy based on preserved photosynthesis (oil). NIBIO is to become the leading national centre for development of knowledge in bioeconomics. The goal of the Institute is to contribute to food security, sustainable resource management, innovation and value creation through research and knowledge production within food, forestry and other biobased industries. The Institute will deliver research, managerial support and knowledge for use in national preparedness, as well as for businesses and the society at large.

NIBIO is owned by the Ministry of Agriculture and Food as an administrative agency with special authorization and its own board. The main office is located at Ås. The Institute has several regional divisions and a branch office in Oslo.