
RESEARCH AND DEVELOPMENT YEARBOOK 2012
RESEARCH AND DEVELOPMENT YEARBOOK 2012. STERF. SCANDINAVIAN TURFGRASS AND ENVIRONMENT RESEARCH FOUNDATION
Sterf

IMPORTANT EVENTS IN 2012

THE NORDIC TURFGRASS GUIDE AND VARIETY LISTS

Evaluation of turfgrass varieties for lawns has a long tradition in the Nordic countries, but national testing was discontinued or strongly reduced 8-12 years ago as public funding was withdrawn. In response to this, SCANGREEN, a variety testing programme for golf greens funded mainly by STERF, was initiated in 2003. SCANTURF, a joint Nordic evaluation programme for lawn and sports turf (not greens) funded by entrance fees only, was set up by Scandinavian researchers and representatives from the European turf seed industry in 2005.

Based on national testing from 1980 to 2005 and the initial SCANGREEN trials, STERF launched its first 'Nordic Turfgrass Variety Guide' in 2007. It was a 'heavy' publication with 15 pages of general information about turfgrass species and about 100 pages of variety descriptions. It was well received, but many users asked for simpler ranking lists that could be updated every year, similar to those published by the STRI/BSPB in the UK.

When the 'Nordic Turfgrass Variety Guide' was revised in 2011-12, it was split into two parts:

1. A general grass guide advising on turfgrass species, not on varieties, to be updated at five-year intervals.
2. Variety ranking lists for golf greens, lawns and sports turf, to be updated every year.

The revision was completed in October 2012 and both publications are now available in English and Nordic languages at http://sterf.golf se. The 22-page Grass Guide contains short texts about 15 cool-season species and subspecies, a table ranking species for important aesthetic and functional characteristics, a table showing their recommended area of use, a turfgrass glossary and many illustrating photos.

The 20 variety ranking lists were updated in Dec. 2013 with 'New Variety' sections based on the latest results from 2012. Besides being accessible at http://sterf.golf se, these lists are also available at www.scanturf.org in a version that allows users to rank varieties for the characters (e.g. winter hardiness, density, resistance to specific diseases) they find most important for their particular area of use.

The Grass Guide and the Variety List have been launched and introduced at several Nordic seminars for practitioners within the industry.

RED FESCUE WORKSHOP

Results from research may have to be adjusted and refined when facing the experiences from turfgrass managers. The STERF red fescue project group took this fact seriously. A two-day workshop was set up in Copenhagen in October. The aim was to bring together the most experienced red fescue greenkeepers in the world. Eight countries were represented when 23 golf course managers brought forward their key factors for successful management of this "low input – high performance" turfgrass species. The hard core of the group consisted of Danish greenkeepers who had been inspired many years ago by the British greenkeeper Chris Haspell to grow red fescue when new legislation restricted pesticide use and water use on golf courses.

On the first day the participants visited three different courses where the greenkeepers aimed for red fescue to be the dominant sward. The excursions set a baseline for the dinner conversations at Smörum GC and the following day at the University of Copenhagen.

A survey conducted before the workshop about maintenance practices was presented together with examples from Iceland and England. During the comprehensive group discussions, notes were taken by consultants and researchers. These notes and data were edited into an illustrated handbook entitled 'Red fescue maintenance – based on greenkeepers' experiences', which can be downloaded in English from sterf.golf.se The handbook also summarises the survey and provides information about the maintenance practices on four different golf courses:

1. The low budget course: Vallø Golf Club, Denmark.
2. The high class course: Furesø Golf Club, Denmark.
3. The commercial course: Smørum Golf Club, Denmark.
4. The new high wear-low input course: Vallda Golf Club, Sweden.

Besides STERF, the workshop was partly funded by the R&A and several sponsoring companies.

EXTERNAL EVALUATION OF NINE COMPLETED PROJECTS

Nine completed STERF research projects within the area 'Turfgrass species and varieties for Nordic golf courses' carried out in the period 2004-2012 have been externally evaluated by an expert panel consisting of scientific experts and representatives from the golf and turfgrass industry. These evaluations concluded that the projects have yielded important and useful information for the industry. Most of the projects were rated good to excellent in terms of achieving their stated objectives, management, scientific achievement and dissemination of results. Allocation of funds to existing research facilities and expertise was deemed to give a high to very high return on project resources provided by STERF. The feedback on the completed projects and suggestions of new R&D initiatives are very valuable for developing and improving STERF´s future programmes and activities.

STERF´S INDUSTRIAL SCIENTIFIC PARTNER PROGRAMME

Global challenges need globally coordinated solutions. STERF currently has interdisciplinary research and development collaborations in Europe, Canada and China, involving both researchers and stakeholders interested in land used for managed turfgrass areas. STERF believes/recognises that research-orientated companies supplying the turf sector are important stakeholders in this respect with much to contribute, and has developed a programme to formalise their involvement, entitled the Industry Scientific Partner Programme.

The involvement of leading suppliers as Industry Scientific Partners further strengthens the important strategic research and development being integrated all the way from producer to end-user. STERF also wants the companies involved to be able to use research results for commercial purposes and therefore invites the partners to participate in the early planning of research, in order to co-ordinate this with its own development and business plans in a more focused variation of the 'open innovation strategy'.

So far, around 10 companies have been invited to become Industry Scientific Partners of STERF. The benefits of being a partner are:

1. Recognition as a STERF Industry Scientific Partner on the STERF website, in STERF annual reports and in all STERF materials.
2. The opportunity to take part in creating the STERF research programme, through participation in the planning process..
3. Collaboration on research projects, and the development of products and more sustainable turfgrass management practices.
4. A world-wide network of contacts with international universities and research centres in the turfgrass sector.
5. Access to public authorities through the STERF network.
6. Free participation in STERF workshops and seminars.
7. A contact day to present and discuss company strategic technical development issues.
8. First-hand information via the STERF newsletter and website.
9. Collaboration in preparation of materials developed for end-users.
10. The pride of taking part in sustainable development of the turf sector.

STERF´S POPULAR HANDBOOKS AND FACT SHEETS

In order to make ready-to-use research results and new knowledge easily accessible to end-users and to provide support to implement changes, which is a prerequisite for achieving improvement in the sustainable management of turfgrass, STERF has decided to present research results and new knowledge as popular handbooks and fact sheets. The following handbooks have been published during 2012:

- Nordic turfgrass variety guide
- Red fescue management – Guidelines based on greenkeepers´experiences
- Playing quality on golf courses
- Golf course pond management
- 20 Danish fact sheets within integrated pest management

COLLABORATION BETWEEN CTRF AND STERF

Collaboration between CTRF (Canadian Turfgrass Research Foundation) and STERF (Scandinavian Turfgrass and Environment Research Foundation) has been discussed and started during 2012, including at a joint meeting held in Calgary in February 2012. The challenges the golf sector has to face in Canada and the Nordic countries are very much the same and statement of intent and strategic objectives are similar for CTRF and STERF. CTRF and STERF have a common interest in promoting high-quality turf on golf courses and sports fields, while also guaranteeing that ecosystem protection and enhancement are fully integrated into golf facility planning, design, construction and management. This can be strengthened through CTRF and STERF co-operating on various R&D issues.

These co-operative efforts will give:

- Better identification of areas for research
- Optimal use of resources:
  - More research and new know ledge per euro/dollar invested
  - Avoided funding of duplicate projects in critical R&D areas
  - Establishment of networks that increase opportunities for cooperation and matched funding of research
- Larger financial base
- Collaboration between researchers and opportunities for transdisciplinary approaches, which will give more reliable results and knowledge.
- Opportunities for increased scientist mobility
- A wider international network and greater influence at international level

Examples of practical collaboration are:

- Dissemination of research results and new knowledge
- Coordination of R&D areas of high priority within thematic areas
- Coordination of research projects
- Coordination of calls for proposals

Collaboration on dissemination of research results and new knowledge, and coordination of R&D areas and research projects has started during 2012.

THE THIRD EUROPEAN TURFGRASS CONFERENCE

Since the foundation of the European Turfgrass Society (ETS) in 2007, the biennial ETS conferences have been an important meeting place for the turfgrass industry. The third conference was hosted by the Bioforsk Turfgrass Research Group and was held in Kristiansand, Norway, on 24-26 June 2012. A total of 130 delegates from 21 countries (plus 16 US states) attended the conference.

STERF researchers headed by Director Maria Strandberg highlighted the overall conference topic with an introductory keynote speech on 'Quality Turf and Efficient Utilisation of Resources'. This topic summarised the overall challenge facing the turfgrass industry, namely: To develop and implement more environmentally and economically sustainable management practices without sacrificing the aesthetic or functional quality of the green areas. Following this introductory session, the two day-programme included 31 oral and 46 poster presentations split into eight thematic sessions. There was also an excursion to the Bioforsk Turfgrass Research Centre at Landvik to view many of the ongoing STERF projects.

Unlike at earlier ETS events, scientists attending the third ETS conference were given the opportunity to submit full research papers for publication in a special turfgrass issue of the peer-reviewed journal Acta Agriculturae Scandinavia (Volume 62, Supplement no 1). STERF covered the costs associated with publication of this special issue, for which 19 papers made it through the two-step review process and were finally accepted. As at earlier conferences, the remaining scientific papers were presented as reviewed two-page abstracts in a book of proceedings (Bioforsk Fokus 7 (8)). Abstracts of all papers presented at the conference are available at www.turfgrasssociety.eu.

ABOUT STERF

Scandinavian Turfgrass and Environment Research Foundation (STERF) is a research foundation that supports existing and future R&D efforts and delivers 'ready-to-use research results' that benefit the Nordic golf sector. STERF was set up in 2006 by the golf federations in Sweden, Denmark, Norway, Finland, Iceland and the Nordic Greenkeepers' Associations.

VISION

STERF is the leading international centre of expertise in sustainable golf course management.

PRINCIPAL STRATEGIES

Approach: Research financed by STERF should be carried out at universities or research institutes (or equivalent) where most of the research capacity is concentrated. STERF has no research capacity in the form of staff or facilities. The work is carried out in project form and is user-driven.
Capacity: STERF strengthens research capacity by encouraging and supporting networks and collaborating actively with key organisations in the field of turfgrass management.
Application: STERF delivers ready-to-use results allowing excellent playing quality through environmentally sound management.
Resources: STERF receives funding from participating golf associations, which can be complemented by funding from other sources. STERF is an independent research foundation even when funding is provided by other sources.

STERF BOARD

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Torben Kastrup Petersen, Danish Golf Union
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BACKGROUND

Managed turfgrass areas such as golf courses, sport fields, landscaped amenity areas and public parks all provide an important social, environmental and economic resource for both urban and rural communities. These areas serve a multifunctional purpose by offering valuable open spaces for recreation, helping to improve the health and quality of life for individuals and, when designed and managed appropriately, enhancing biodiversity and supporting regulatory targets for environmental protection. Conversely, where turfgrass management practices are inadequate or inappropriate, their services to society are reduced, and their impacts on the natural environment can be damaging and costly.

The Nordic golf federations have approx. 900 000 members, playing golf on more than 900 courses that cover a total area of more than 58 000 ha. Any societal activity as significant as golf must take responsibility for building knowledge through research and development (R&D). R&D is, and will continue to be, a necessary and strategically important investment for the Nordic golf sector in achieving economically and environmentally sustainable golf facilities of high standard and in establishing the credibility of golf as an environmentally friendly sport. Golf facilities that are already using new knowledge are achieving cost savings through more efficient management strategies, while also enhancing the golf course, heightening the profile of the golf facility and improving the environment.

The golf and turfgrass sector relies on natural resources and co-existence with the environment and there are several important reasons why Nordic R&D is necessary. In Central Scandinavia, Oslo, Stockholm and Helsinki lie at the same latitude as the southern tip of Greenland (~60oN). This gives a unique climate resulting from a combination of factors such as light, temperature and precipitation during the playing season and especially during the winter season. The Nordic climate creates conditions for plant growth and the construction and management of golf courses, sport fields etc. that are not found anywhere else in the world. Changes in climate will also have significant and profound implications for the Nordic golf and turfgrass industry. The sector needs to plan for adaptation to climate change. The sector must also seek to play a credible part in minimising factors affecting climate change, through the adoption of greater resource efficiency actions, combined with measures to protect and enhance ecosystems.

The depletion of the earth's natural resources is one of the most pressing environmental concerns, which is directly connected to ecosystem damage and the emission of climate-changing greenhouse gases. Reducing resource consumption is central to this effort. It also makes absolute business sense to reduce unnecessary expense and waste through efficient consumption of energy and materials. For the golf and turf sector this means continuous improvement towards energy and resource efficiency combined with improved waste management, which maximises reuse and recycling. It also means applying new renewable energy alternatives, utilising products made from recycled materials, and reducing embodied energy through the development of low energy supply chains, which would also promote the purchase of local products and services.

Few leisure activities have such an intimate interaction with the environment as golf. Golf does not have an inherent positive or negative impact on nature and biodiversity. The overall impact depends on the attributes of each site and the attention to detail in planning, design, construction and management of facilities. Golf courses include large areas of land that are not

used for the game. Therefore there is potential for better use of the land in order to provide new opportunities for active outdoor life. A multifunctional golf course views its operations from the broad, general perspective. In addition to providing a high quality arena for golf, it supplies various services that are beneficial for society at large, e.g. increasing biological diversity and protecting natural and cultural environments, and is available for active outdoor recreation, without compromising safety. Continual supporting R&D is needed to develop and establish multifunctional golf facilities, provide protection for unique Nordic ecosystems and prove that golf courses are often positive within local environments, and may be comparable to many natural and semi-natural habitats in terms of animal and plant diversity.

The golf and turfgrass industry is influenced by the requirements of public authorities and also by increasing environmental awareness among the general public. Good examples of this are various new and existing EU Directives related to pesticides, water, soil, nitrate, pollution, habitats etc. The EU Directive on sustainable use of pesticides has introduced an integrated approach to pest and disease management as the driving force for producing healthy turf and reducing pesticide use. The main focus of integrated pest management is a decision-making process utilising all suitable techniques to produce quality turf and minimise pest damage and pesticide use below the levels causing economically unacceptable damage or loss. In the future, turfgrass management must be more focused, effective, structured and targeted.

Only by continually supporting R&D can we provide the golf and turfgrass sector with access to information and tools based on research and development for integrated pest management, keep ahead of developments and influence the new national and European legislation affecting the golf and turfgrass industry. STERF, together with the Nordic golf sector, universities, research institutions and authorities, can take responsibility for ensuring that R&D activities that are important for integrated pest management are coordinated and executed and that new knowledge is delivered. STERF can contribute to the development of expertise through communicating new knowledge and relevant tried and tested experience in an integrated pest management perspective. STERF in partnership with consultants and good practitioners can take responsibility for ensuring that a Nordic model for systematic documentation of golf course maintenance is developed.

RESEARCH OBJECTIVES AND PRIORITY AREAS

STRATEGIC RESEARCH OBJECTIVES

The golf and turfgrass industry, like other land-based industries, has to take responsibility for sustainable societal development, i.e. produce golf courses and other turfgrass areas of a high standard while at the same time ensuring the sustainable use of natural resources and contributing to functioning ecosystems.

The aim of STERF is to support R&D that can help the golf industry to fulfil these ambitions. The activities of STERF should lead to improvements in the quality of golf courses, as well as economic and environmental gains for the industry and society as a whole.

The strategic objectives for STERF-funded R&D activities are that:

- The design, construction, management and administration of golf courses provide optimal conditions for playing quality, the degree of utilisation of the course, and management inputs.
- The design, construction, management and administration of golf courses are economically and environmentally sustainable, for example with respect to plant nutrient requirements, water and energy use, drainage and control of weeds and plant diseases.
- Golf courses contribute to improving the relationship between golf and ecosystems, enhance the natural and cultural values of the landscape and promote biodiversity.

INTERNATIONAL INTERDISCIPLINARY THEMATIC AREAS

It is apparent that the golf and turfgrass industry faces a number of local and international challenges, all of which will need concerted and collective solutions, underpinned by robust, applied science. To meet these challenges, STERF has identified and set up four international and interdisciplinary thematic areas.

These four thematic areas are:

INTEGRATED PEST MANAGEMENT

New and existing regulations on national and international level related to the turfgrass industry are becoming more strict. A good example of this is the EU directive on sustainable use of pesticides, including strategies for integrated pest management. STERF, together with the Nordic park and golf sector, universities, research institutions and authorities, takes responsibility for ensuring that R&D activities that are important for integrated pest management are coordinated and executed and that new knowledge is delivered.

MULTIFUNCTIONAL GOLF FACILITIES

Multifunctional golf courses can contribute to the achievement of international and national environmental targets and help improve people's health and quality of life by providing facilities for active outdoor recreation. Through STERF´s R&D programme within multifunctional facilities, the Nordic area can become a model region as regards multifunctional golf courses and collaborations between different interests in society.

SUSTAINABLE WATER MANAGEMENT

Water is essential to secure the future of the golf and turfgrass industry and the livelihoods of many rural communities that depend upon it. STERF's goal is to provide science-based information on integrated management practices, based on existing knowledge and new research results, to reduce water consumption, protect water quality and document the effects – both positive and problematic – of well-managed turfgrass areas on water resources.

WINTER STRESS MANAGEMENT

Winter damage is the foremost reason for dead grass, reducing the aesthetic and functional value of turf. UN-IPCC climate scenarios predict that due to high precipitation and unstable temperature, ice and water damage will become the most important cause of winter damage in the future. STERF takes responsibility for developing strategic expertise and new knowledge to avoid and manage such damage.

Two key objectives of this initiative are:

- to coordinate design and execution of R&D activities around the core themes
- to create effective dissemination of the resulting new knowledge through channels and formats which are easily accessible to end-users.

Progress in these areas will collectively lead to improvements in the quality of golf courses and managed turfgrass areas, as well as economic and environmental gains for the industry.

SCANGREEN: TURFGRASS SPECIES AND VARIETIES FOR INTEGRATED PEST MANAGEMENT OF SCANDINAVIAN PUTTING GREENS

PROJECT PERIOD: JANUARY 2011 – DECEMBER 2014

FUNDING (kSEK)

	2011	2012	2013	2014	Total
STERF	475	441	427	427*	1770
Variety entrance fees	80			80	160
Other sources	136	86	86	88	395
SUM	691	527	513	595	2 325

* Reserved but not granted

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COMPANIES ENTERING CANDIDATE VARIETIES INTO THE PROJECT

DLF Trifolium, Barenbrug, Graminor, Eurogreen, Scandinavian Seed and Seed Research of Oregon.

TALKS AT CONFERENCES MEETINGS, SEMINARS, FIELD DAYS, ETC (2012)

6 Feb: Bioforsk Annual Conference, Section Ornamentals and Turfgrasses, Gardermoen, Norway
9 May: Training course for Garden and Park Engineers, Nødebo, Denmark
25 June: European Turfgrass Conference, Oral Presentation and Excursion to Landvik
22 Oct: Training course for Landscape Architects, Frederiksberg, Denmark
6 Nov: Danish Greenkeeper Week, Fjerritslev, Denmark
12 Nov: Norwegian Golf Federation Seminar, Ullevål, Norway
20 Nov: Higher Greenkeeper Education (HGU), Bärsebäck, Sweden.
28 Nov: Modern golf course management, Malmö, Sweden
29 Nov: Modern golf course management, Gothenburg, Sweden
30 Nov: Modern golf course management, Stockholm, Sweden

PROJECT SUMMARY AND STATUS BY 1 JANUARY 2013

STERF's SCANGREEN programme was initiated in 2003 and the third round of testing (this project) started in 2011. The test sites are Korpa GC, Reykjavik, Iceland (64°N) and Bioforsk Apelsvoll, Norway (62°N) in the northern Scandinavian test zone, and Bioforsk Landvik, Norway (58°N) and Sydsjælland GC, Denmark (56°N) in the southern zone. A total of 38 varieties, including controls, are being evaluated: 10 of *Festuca rubra* ssp. *commutata*, 6 of *Festuca rubra* ssp. *trichophylla*, 8 of *Agrostis stolonifera*, 5 of *Agrostis capillaris,* 1 of *Agrostis castellana*, 2 of *Agrostis canina*, 1 of *Poa trivialis*, 1 of *Poa supina*, and 4 of *Lolium perenne*. Once grow-in is completed, standard mowing height is 5 mm for F. *rubra, L. perenne, P. supina* and *P. trivialis* and 3 mm for *Agrostis* sp. Annual fertiliser rate is 1.4-1.6 kg N/100 m^2 for *A. stolonifera, L. perenne* and *Poa* sp., and 0.9-1.0 kg N/100 m^2 for *F. rubra, A. canina, A. capillaris* and *A. castellana*. The trials are exposed to wear from golf-type

soft spikes mounted on a friction-type wear drum (Photo 1) simulating 20 000 - 30 000 rounds of golf per year. No pesticides are used in the trials.

The trials at Landvik, Apelsvoll and Korpa were seeded in July 2011. At Landvik, all plots reached 100% coverage in autumn 2011 and survived the first winter without damage. At Apelsvoll, fescues established more slowly than other species and were reseeded in spring 2012 along with *L. perenne* and *A. castellana*, which suffered >80% winter kill . The bentgrasses were the slowest in establishment at Korpa; at this site *A. capillaris* and *A. canina* were also severely attacked by microdochium and had to be reseeded along with *L. perenne* in spring 2012. The trial at Sydsjælland was seeded in late September 2011 and did not reach complete coverage until autumn 2012 (Photo 2).

In December 2012, the data from 2011 and 2012 were analysed by ANOVA and used for a preliminary update of the SCANGREEN lists available at http://sterf.golf.se and www.scanturf.org. So far, the most promising newcomers are: (S=southern zone, N=northern zone):

- *A. stolonifera*: 'Cobra Nova' (S+N), '007' (S) and 'Teeone' (N)
- *F. rubra* ssp. *commutata*: 'Barlineus' (S+N), 'Caldris' (S+N), 'Bargreen II' (S+N), 'Nikky' (S) and 'Valetta' (N)
- *F. rubra* ssp. *litoralis*: 'Nigella' (N), 'Beudin' (N)
- *L. perenne:* 'Columbine'(N), 'Sauvigone' (N)

A few more may be included once they have been given official names. *P. trivialis* 'Dark Horse' and *P. supina* 'Supranova' also made a good overall impression in the northern zone.

Photo 1. Wear machine constructed for use in the trial at Sydsjælland GC. Photo: Trygve S. Aamlid.

Photo 2. Head greenkeeper Per Sørensen, Sydsjælland GC, points out one of his favourite cultivars of red fescue. Photo taken on 9 October 2011 by Trygve S. Aamlid.

THE NORDIC TURFGRASS GUIDE 2012 AND VARIETY LISTS

PROJECT PERIOD: APRIL 2011 – OCTOBER 2012

FUNDING (kSEK)

	2011	Total
STERF	82	82
Other sources	0	0
SUM	82	82

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TALKS AT CONFERENCES, SEMINARS, MEETINGS ETC. IN 2012

6 Nov: Danish Greenkeeper Week, Fjerritslev, Denmark
12 Nov: Norwegian Golf Federation Seminar, Ullevål, Norway
20 Nov: Higher Greenkeeper Education (HGU), Bärsebäck, Sweden.
28 Nov: Modern golf course management, Malmö, Sweden
29 Nov: Modern golf course management, Gothenburg, Sweden
30 Nov: Modern golf course management, Stockholm, Sweden

PROJECT SUMMARY AND STATUS AS OF 1 JANUARY 2013

The first 'Nordic turfgrass variety guide' was launched in 2007. It was based partly on the STERF project 'Evaluation of *Festuca* and *Agrostis* varieties for use on Scandinavian golf greens' (2003-2006) and partly on national testing of turfgrass varieties in the Nordic countries from 1980 to 2005. The guide was a 'heavy' publication with 125 pages, about 100 of which were variety descriptions. It was well received, but many users asked for simpler ranking lists similar to those published by the STRI /BSPB in the UK. Another response was that the guide would be more useful if variety descriptions were replaced by general information about species.

When publishing the guide in 2007, it was predicted that it would have to be updated every 3-4 years based on data obtained in the SCANGREEN projects funded by STERF and on SCANTURF, a joint Nordic evaluation programme for all types of turf except greens. SCANTURF is coordinated by Bioforsk and funded entirely by variety entrance fees.

When this project started in spring 2011, it was decided to split the guide into two parts:

1. A general Grass Guide to be published in both English and Scandinavian languages at http://sterf.golf.se. This guide would advise on turfgrass species, but not go into detail about varieties.
2. Variety ranking lists to be published at http://sterf.golf.se and www.scanturf.com

The Grass Guide was presented in September 2012 and is now available in English, Norwegian and Swedish. Besides agronomic descriptions of 15 cool-season species and

subspecies, the guide includes tables that rank the grasses for important aesthetic and functional characteristics and show their recommended area of use. It also contains a grass glossary.

The variety lists that are now available include results from various Scandinavian testing programmes since 1985. Amalgamation has been possible because control varieties were mostly the same in all programmes. Varieties for greens are presented separately for a southern Scandinavian zone including Denmark and coastal areas of Southern Sweden and Southern Norway; and a northern zone including Finland, Iceland and the remaining parts of Sweden and Norway. In contrast, varieties for lawns, fairways and football pitches (SCANTURF) are presented as joint lists for the entire Nordic regions because of fewer test sites and less external funding.

It is the intention to update both the SCANGREEN and SCANTURF lists every year in December as new varieties come to the market and others are withdrawn. The first update was made in December 2012.

Photo: Evaluation of varieties of *Lolium perenne* and *Poa pratensis* for wear tolerance. Photo: Trygve S. Aamlid

FESCUE-GREEN: BEST MANAGEMENT OF RED FESCUE (*FESTUCA RUBRA*) GOLF GREENS FOR HIGH SUSTAINABILITY AND PLAYABILITY

PROJECT PERIOD: JULY 2011 – JULY 2015

FUNDING (kSEK)

	2011	2012	2013	2014	2015	Total
STERF	300	600	600	600*	300*	2 400
Other sources	153	295	204	178	43	873
SUM	453	895	804	778	343	3 273

* Reserved but not granted

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TALKS AT CONFERENCES, SEMINARS, MEETINGS ETC. IN 2012

1 March: Project reference group meeting, Copenhagen;
- Introduction to FESCUE-GREEN
- Current status and knowledge gaps for use of red fescue on Danish golf courses
- Red fescue greens in Norway
- Fescue on putting greens in Sweden
- Use of red fescue on golf courses in Iceland
- Overview of British research relevant for management of fescue greens
- Plans for subproject 1: Irrigation strategy and seasonal fertilizer distribution on established fescue greens
- Introduction to subproject 2: Turf health and playability at high mowing and replacement of mowing with light weight rolling
- Use of compost in the rootzone and/or in the topdressing sand on fescue greens. Experimental set-up of subproject 3 and results from 2011.

11 Oct: Introduction to STERF's project FESCUE-GREEN. International red fescue workshop, Copenhagen

PROJECT SUMMARY AND STATUS AS OF 1 JANUARY 2013

Recent STERF projects and practical experience suggest that red fescue (*Festuca rubra*) is the optimal species for sustainable management (IPM) of Nordic golf greens. This project is examining how to maintain pure fescue greens with less *Poa annua* and optimal playing quality.

Subproject 1 is focusing on irrigation and seasonal fertiliser distribution. A field trial will be conducted in 2013 and 2014 under a mobile rainout shelter covering a USGA-green seeded in September 2011 with a mixture of 97% red fescue and 3% *Poa annua* at Landvik, Norway. Light and frequent deficit irrigation and irrigation to field capacity at different intervals will be compared in combination with three seasonal distributions patterns with a total N input of 0.9 kg N/100 m^2.

Subproject 2 is being conducted on a well-established green dominated by red fescue at Smørum GC, Denmark (Photo). The focus is on mowing height (5 or 6 mm),

mowing frequency (3 or 5x/wk), and lightweight rolling (0, 2 or 4x/week). The trial started in July 2012 with characters such as green speed, surface firmness, root development, organic matter content in the mat layer, diseases and botanical composition (*Poa annua* invasion) being recorded at regular intervals.

Subproject 3 is investigating the benefits of composted garden waste ('Green Mix') as an organic amendment in the rootzone or topdressing sand on fescue greens at Landvik, Norway and Smørum, Denmark. The main trial at Landvik was seeded on 17 August 2011 and all plots received a seasonal fertiliser input of 1.3 kg N, 0.06 kg P and 1.1 kg K/100 m^2 in 2012. Results from the first growing season suggest significantly better overall impression after using Green Mix instead of Sphagnum peat in the rootzone. During the latter part of the growing season, a positive effect of including Green Mix in the topdressing also became apparent. Green Mix in the rootzone led to more *Poa annua* during the first part of the growing season (mean 17%, vs. 11% in peat-amended rootzones), but after a dry period in July, *P. annua* almost disappeared, regardless of amendment. In October 2012, Master's student Tina Anderson found that more fescue roots were colonised by mycorrhiza in rootzones amended with Green Mix than in those amended with peat.

Photo: Inspection of ball roll using a Pelzmeter on the fescue green used for subproject 2 at Smørum GC, Denmark. Photo: Agnar Kvalbein.

EFFECTS OF MOWING HEIGHT, N-RATE AND P-RATE/MYCORRHIZA ON QUALITY AND COMPETITION AGAINST ANNUAL MEADOWGRASS ON PUTTING GREENS WITH RED FESCUE AS PREDOMINANT SPECIES

PROJECT PERIOD: MAY 2011 – DECEMBER 2014

FUNDING (kSEK)

	2011	2012	2013	2014	TOTAL
STERF	207	150			357
Other sources	138	140	140		418
TOTAL	345	290	140		775

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Tina E. Andersen, M.Sc. student, Norwegian University of Life Science, Norway (2011-12)

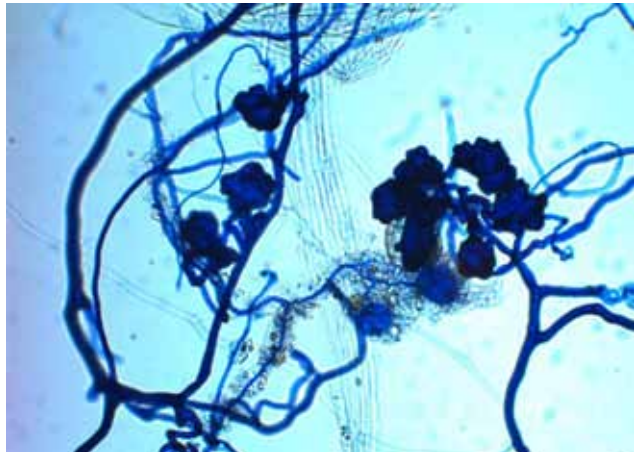
TALKS AT CONFERENCES, SEMINARS, MEETINGS ETC. IN 2012

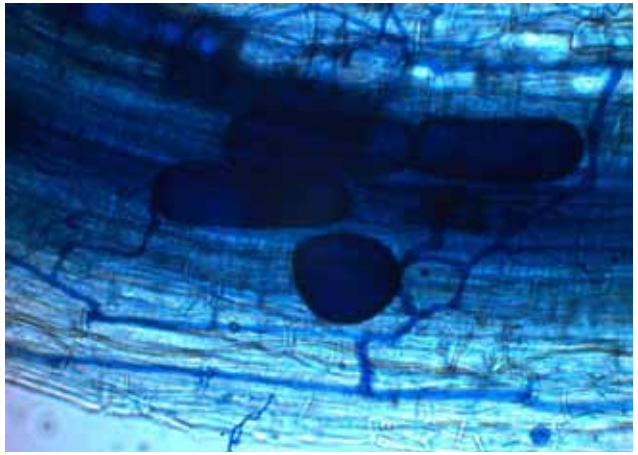
25 June: Third ETSC, Kristiansand, field excursion

PROJECT SUMMARY AND STATUS AS OF 1 JANUARY 2013

Red fescue (*Festuca rubra)* is the most environmentally friendly turfgrass species used on golf greens. Among its advantages are low water and nitrogen requirements and high resistance to snow moulds. To improve wear tolerance, colour and other quality parameters of fescue greens, the species is traditionally sown in mixture with colonial bentgrass (*Agrostis capillaris*). The use of red fescue in mixture with velvet bentgrass (*Agrostis canina*) appears to be promising, at least regarding the low N requirement of both species and the fact that mixtures with velvet bentgrass are denser and thus more competitive to annual meadowgrass (*Poa annua*). As green maintenance has an impact on competition between species, the project is examining the effects of mowing height (4 mm or 5.5 mm), N-rate (0.5, 1.0 or 1.5 kg/100 m^2) and P-rate (0 kg or 0.18 kg P/100 m^2) on green quality, thatch formation and competition against annual meadowgrass with a peat-amended rootzone (10% v/v). Another topic under investigation is mycorrhiza (Photos) in terms of the possibilities for its establishment from a commercial product and its importance for green quality and competition against annual meadowgrass. The experiment is being carried out on a USGA-spec. green established in August 2010 and the treatments started in June 2011.

Preliminary results: Putting greens with red fescue as the predominant species required at least 1.0 kg N/100 m^2 per year to produce a quality ranking of 5 (=acceptable) or higher on peat-amended rootzones. However, increases in N (and P) rate also increased competition from annual meadowgrass. Pure red fescue greens had lower visual quality than mixed greens at 1.0, or 1.5 kg N/100 m^2, but not at 0.5 kg N/100 m^2. Only mixed greens were able to compete against annual meadowgrass. Mycorrhizal colonisation on turfgrass roots amounted to 63-68% and was affected only by N fertilisation. Low N input (0.5 kg/100 m^2) led to 3 percentage points higher mycorrhizal colonisation than 1.0 or 1.5 kg N/ 100 m^2.





Photos. Often referred to as the 'roots of roots', the symbiotic relationship with mycorrhiza extends the root system of turfgrasses, thus enabling them to absorb more nutrients, especially P. Photo: Tina E. Andersen.

OVERSEEDING OF FAIRWAYS - A STRATEGY FOR FINER TURF WITH LESS BROADLEAVED WEEDS AND *POA ANNUA*

PROJECT PERIOD: APRIL 2011 – DECEMBER 2014

FUNDING (kSEK)

	2011	2012	2013	2014	Total
STERF	170	156	156	177	659
Other sources	92	92	93	20	297
SUM	262	248	249	197	956

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TALKS AT CONFERENCES, SEMINARS, MEETINGS ETC. IN 2012

7 Feb: Bioforsk conference, Gardemoen, Norway
9 May: Training course for Garden and Park Engineers, Nødebo, Denmark
23 May: Field day for greenkeepers at Skovbo golf course, Denmark
26 June: ETS conference, Field day, Landvik, Norway
22 Oct: Training course for Landscape Architects, Frederiksberg, Denmark

PROJECT SUMMARY AND STATUS AS OF 1 JANUARY 2013

Research concerning management of golf course fairways has so far been neglected compared with golf greens. Legislation regarding pesticide reduction will cause serious problems with *Poa annua* and broadleaved weeds in years to come. Establishing a strong competitive turfgrass sward might be one solution in order to avoid massive invasion of weeds. This can be accomplished with an appropriate overseeding strategy adapted to the Nordic countries.

This project is testing a variety of parameters that influence the outcome of an overseeding procedure. This includes overseeding date, fertilisation and turfgrass species. Tests are being performed on an experimental fairway at Landvik (Bioforsk, Norway) and on three golf courses (Korsør, Hornbæk and Skovbo) in Denmark over a three-year period (2011-2013). Grass species composition, weed occurrence and overall performance are being recorded. In addition, the economic costs of the different procedures will be estimated for a standard golf course at the end of the project.

Overseeding was performed according to plan in 2011 and 2012 in Denmark and Norway. Furthermore, grass composition and weed occurrence were measured in spring in Denmark and in spring and autumn in Norway, in combination with overall

performance/appearance every month. The effect of an overseeding procedure is not assumed to be clear after just one year of data and therefore a preliminary statistical analysis will be carried out after 2 years of measurements.

Preliminary screening of data collected in Denmark indicates that perennial ryegrass is well established after overseeding on the three golf fairways. In autumn 2012 ryegrass establishment could easily be seen on the fairways. The application of a high-P fertiliser when overseeding changed the visual appearance of the plots so that they appeared greener.

Photo 1 (small) . Skovbo golf course, Denmark, autumn 2012 – perennial ryegrass used for overseeding in spring can be seen appearing in rows. Photo: Anne Mette Dahl Jensen.

Photo 2 (big). Korsør golf course, Denmark, 3-4 weeks after spring treatment in 2012. There is a clear visual effect of applying fertiliser with a high P content. Photo: Niels Andersen.

WEED CONTROL ON FAIRWAYS

PROJECT PERIOD: MARCH 2011 - DECEMBER 2013

FUNDING (kSEK)

	2011	2012	2013	Total
STERF	30		40	70
Other sources	40	15	15	70
SUM	70	15	55	140

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Ole Sams Falkenberg, Hunsballe frø
Ole Vestergård, Grøn service

TALKS AT CONFERENCES, SEMINARS, MEETINGS ETC. IN 2012

9 May: Training course for Garden and Park Engineers, Nødebo, Denmark
22 Oct: Training course for Landscape Architects, Frederiksberg, Denmark

PROJECT SUMMARY AND STATUS AS OF 1 JANUARY 2013:

Experiences from football pitches indicate that management practices including deep slicing and placement of fertiliser and seed within the soil can reduce weed occurrence and create a denser grass cover.

This project is testing a management method involving fertiliser placement, frequent, deeper turf slicing and deep seed sowing on golf course fairways over a 3-year period. The hypothesis is that the turf in the treated fairways will become denser and the weed population will be significantly reduced with this management method. The denser turf population is expected to lead to reduced use of herbicides on the two golf courses studied. The method will most likely also reduce the use of fertilisers, because the fertiliser is placed in the growing zone near the roots of the turf, where it can be used efficiently.

A large-scale experiment on the St. Knuds and Odense golf courses was initiated in 2011. Weed occurrence was estimated in spring and fertiliser was applied twice during the growing season. Unfortunately, Fyn (the Danish island where the two courses are located) was plagued by heavy rain during autumn 2011 and it was impossible to fertilise and overseed without damaging the fairways.

In 2012, Odense golf course withdrew from the project due to a staffing reduction and the experiment was moved to a sports field in Nyborg. Weed occurrence on the sports field was assessed before treatments. The fairway at St. Knuds golf course and the

sports field were fertilised four times during the growing season of 2012 and over-seeded in autumn.

Fairway and sports field plots which were sliced, or sliced and given additional fertiliser, visually appeared greener and denser. This reflects the fact that most fairways and many public sports fields in Denmark receive a limited amount of fertiliser. On golf courses the average is 50 kg/ha, which may limit grass growth. Weed assessment will be carried out at the end of the project according to the experimental plan.

Photo: Experimental work at the sports field in Nyborg, Denmark, spring 2012. Photo: Anne Mette Dahl Jensen.

OPTIMAL MAINTENANCE FOR HARDENING AND EARLY SPRING GROWTH OF GREEN TURFGRASS

PROJECT PERIOD: JANUARY 2005 - DECEMBER 2012

FUNDING (kSEK)

	2006	2007	2008	2009/10	2011/12	Total
STERF		1 000	1 100	1 220	480	3 800
Other sources	500	500	500			1 500
SUM	500	1 500	1 600	1 220	480	5 300

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TALKS AT CONFERENCES, SEMINARS, MEETINGS ETC. IN 2012

25-27 June: Third European Turfgrass Conference ETS Conference. Oral presentation - Influence of fertilization regime on carbohydrate content of turf grass

PROJECT SUMMARY AND STATUS AS OF 1 JANUARY 2013

The aim of this study was to identify management strategies which could increase winter stress tolerance, i.e. decrease winter damage and promote early green-up in spring, of the common Scandinavian golf green turfgrasses creeping bentgrass (*Agrostis stolonoifera*), a mix of chewings fescue (*Festuca rubra* ssp. *commutata*) and slender creeping red fescue (*Festuca rubra* ssp. *litoralis*), and annual meadowgrass (*Poa annua*). This involved manipulating nitrogen, fungicide and a spring protective cover on a golf course in the Mälaren region of Sweden. The fructan concentration in plant tissue was used as an indicator of winter stress tolerance and biomass in grass clippings in early spring as an indicator of early green-up.

The experiment was run for three years (autumn 2006-summer 2009). Four different fertilisation treatments were tested: traditional fertilisation (TR), traditional fertilisation with late N application, demand-driven fertilisation (DD) and demand-driven fertilisation with late N application. In addition, treatments with and without fungicide application and with and without spring cover were tested. Observations of winter damage was performed every spring. Biomass and N concentration in grass clippings and fructan content and N concentration in plug samples were measured.

The tissue N concentration was an important regulating factor for biomass production and fructan content, with high N concentrations giving higher biomass production and lower fructan concentrations, and vice versa. A late N application generally resulted in higher tissue N concentrations and higher biomass production in April than no late N application.

The winter temperatures were very mild during the experiment and subsequently winter damage was minimal. Although there were differences in fructan content between the TR and DD treatments, this did not reflect any significant differences in winter damage. The fungicide treatment decreased winter damage by 6-8% for creeping bentgrass and 30-35% for annual meadowgrass. There was also a tendency for late N application to have a repressive effect on winter damage. The use of a spring cover had very limited effects on any of the grasses.

Photo: Fescue trial areas at Fullerö GK, April 2007. Photo: Maria Strandberg

BETTER TURFGRASS SURVIVAL IN A CHANGING WINTER CLIMATE

PROJECT PERIOD: JUNE 2011 – DECEMBER 2014

FUNDING (kSEK)

	2011	2012	2013	2014	Total
STERF	396	396	396	396	1 584
Other sources	1 073	1 347	1 097	887	4 404
SUM	1 469	1 743	1 493	1 283	5 988

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Mats Höglin, Bioforsk Vest Særheim, Norway
Jim Ross, Prairie Turfgrass Research Centre, Canada
Michelle DaCosta, University of Massachusetts, USA

TALKS AT CONFERENCES, SEMINARS, MEETINGS ETC. IN 2012

25 JUNE: Third ETSC, Kristiansand, field excursion
10 SEPT: Reference group meeting, Landvik

PROJECT SUMMARY AND STATUS AS OF 1 JANUARY 2013

This project is investigating how to reduce winter damage to grasses on golf courses, recreational areas and pastures through better understanding of dehardening reactions and appropriate management in a wetter and less stable winter climate. The project is divided into three work packages (WP). Briefly, subgoals and status for these are:

WP1: To define deacclimation susceptibility in early winter of six turfgrass species used on golf greens. In late November 2011, turfgrass cores were taken from a USGA green at Bioforsk Landvik (coastal location). Plants were deacclimated at 10 °C for 0, 6 and 12 days and tested for freezing tolerance as determined by lethal temperature for 50% of plants (LT50). Creeping bentgrass and annual meadowgrass dehardened more than the other species, but creeping bentgrass was still the most frost-tolerant species after 12-d deacclimation. Velvet bentgrass was also frost-hardy and more resistant to deacclimation than the other species. The experiment is being repeated during winter 2012-13 with one more treatment to test the reacclimation ability of the species.

WP2: To monitor cold hardiness levels of four turfgrass species growing on a fairway with low and high watertable and relate this to soil temperature, crown and soil moisture content and turfgrass storage capacity defined by direct and indirect methods. Four grasses were studied during winter 2011-12 at Bioforsk Landvik (Photo). In addition to LT50, plants were tested for lethal duration for 50% of plants (LD50) at temperatures between -7 and -8 °C. Maximal acclimation was achieved in January. When determined in December, LT50 was highly correlated with LD50. Impeded drainage during the acclimation period from October to

December did not significantly affect crown moisture content or freezing tolerance. The experiment is repeated during winter 2012-13.

WP3: To assess the impact of ice encasement and protective covers on the survival of six turfgrass species (the same as in WP1) under green conditions. A main experiment was conducted on a USGA green at Bioforsk Apelsvoll (inland location) during winter 2011-12. Velvet bentgrass and creeping bentgrass had the best tolerance to ice encasement, although four months with ice (November 2011-March 2012) was not enough to determine the LD50 for these species. An impermeable plastic cover and plastic with 1 cm air space underneath improved the survival of annual meadowgrass. The experiment is being repeated in winter 2012-13 and also supplemented with large-scale demonstration trials on three golf courses in Scandinavia with various turfgrass species on their greens. In 2011-2012 the effects of covers were not consistent among locations.

Photos: Freezing tolerance is an important component of winter hardiness. Plants taken from the field in December, January and March 2011-12 and 2012-13 have been tested for freezing tolerance as indicated by lethal temperature for 50% of plants (LT50). Photo: Tatsiana Espevig.

DEVELOPMENT OF METHODS FOR NON-PESTICIDE WEED CONTROL ON GOLF FAIRWAYS

PROJECT PERIOD: FEBRUARY 2008 – MAY 2013

FUNDING (kSEK)

	2008	2009	2010*	Total
STERF	65	125	250	440
Other sources	612	612	408	1 632
SUM	677	737	658	2 072

* Some money has been transferred to 2012 and 2013.

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TALKS AT CONFERENCES, SEMINARS, MEETINGS ETC. IN 2012

7 Feb: Bioforsk conference, Gardemoen, Norway. 'Golfbanan arena för idrott, naturvård och allmänhet – bekæmpelse af ukrudt uden pesticider'
9 May: Training course for Garden and Park Engineers, Nødebo, Denmark
26 June: ETS conference, Field day, Landvik, Norway
22 Oct: Training course for Landscape Architects, Frederiksberg, Denmark

PROJECT SUMMARY AND STATUS AS OF 1 JANUARY 2013

The project is seeking to develop new strategies for pesticide-free mechanical management of weeds, with the focus on timing and frequency in order to reduce herbicide use.

Preliminary examination of data from 2008 and 2009 indicates that different mechanical treatments can have a small negative effect on the occurrence of the three test weed species; clover, daisy and dandelion. Harrowing and verticutting seem to have a small positive effect on the grass cover. However, the changes in occurrence (negative and positive) are only a few percentage units. So far there are no indications that the methods being tested have the ability to effectively reduce weed occurrence (although a number of data still need to be analysed).

Data from the two field experiments (original project) are in the process of being analysed and a final report will be produced in spring/summer 2013. The analysis is focusing on the effect of the different management practices. The occurrence of weed species during the grass growing season is also being analysed. The weed composition has been examined in spring, early summer, late summer/early autumn and late autumn. Analysis of these data will produce valuable information regarding the behaviour of weed species under an intensive mowing regime.

Data from the weed burning experiment are also in the process of being analysed. The results will be included in the final report. The hypothesis is that a burning intensity can be found at which some weeds species are damaged, but the grass survives.

Unfortunately the planned collection of experience from scalping and the use of composted tea did not occur. Data from greenkeepers were not sufficient.

Many greenkeepers are searching for methods to reduce earthworm casts because they are seen as perfect niches for germination of weed seeds. At Furesø golf course, Thomas Pihl (head greenkeeper) performed a number of experiments on reducing earthworm casts. Experiences from these experiments will be summarised in a short paper.

EVAPORATIVE DEMANDS AND DEFICIT IRRIGATION ON SAND-BASED GOLF GREENS

PROJECT PERIOD: JULY 2008 – DECEMBER 2012

FUNDING (kSEK)

	2008	2009	2010	2011	2012	Total
STERF		395	395	395	294	1 479
Other sources	94*	348**	440**	440**	348**	1 670
SUM	94	743	835	835	642	3 149

* Rainbird irrigation company **Norwegian Research Council

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TALKS AT CONFERENCES, SEMINARS, MEETINGS ETC. IN 2012

26 June: European Turfgrass Conference, Oral Presentation
26 June: European Turfgrass Conference, Poster Presentation
6 Nov: Danish Greenkeeper Week, Fjerritslev, Denmark
12 Nov: Norwegian Golf Federation Seminar, Ullevål, Norway
20 Nov: Higher Greenkeeper Education (HGU), Bärsebäck, Sweden
28 Nov: Modern golf course management, Malmö, Sweden
29 Nov: Modern golf course management, Gothenburg, Sweden
29 Nov: Slovenian Greenkeepers Association's Education Day

PROJECT SUMMARY AND STATUS AS OF 1 JANUARY 2013

Most of the experimental work in this project was finished in 2011 and the project is now coming to an end with scientific papers and a turfgrass irrigation handbook to be published in 2013. The major findings in the project are:

- Turfgrass crop coefficients (Kc) and thus actual evapotranspiration (ET) rates, were always about two-fold higher on the first day after replenishing the soil water content to field capacity (FC) than on subsequent days. Avoiding irrigation to FC is therefore a key factor in saving water.
- There were only minor differences in Kc among the cool-season turfgrasses used on golf courses in Scandinavia.

  - Among grasses used for greens, red fescues and colonial bentgrass transpired 50-60% more water than velvet bentgrass on the first day after replenishment to FC. On the first day, creeping bentgrass also had higher ET than velvet bentgrass (+40%), although not as high as the fescues or colonial bentgrass. We believe this is due to the more humid microenvironment (thicker boundary layer) above the higher density bentgrasses, which are usually cut at 3 mm, than above fescue and fescue/bentgrass mixtures, which are usually cut at 5 mm. On the second and following days after replenishment to FC, differences in ET rates were not significant. For these days, the average Kc on greens was 0.83.

- Among grasses used on fairways, perennial ryegrass and slender and strong creeping red fescue had higher Kc (2.9-3.3) than chewings fescue (2.2) on the first day after irrigation to FC. Common meadowgrass was intermediate, with a Kc of 2.5. With a mean value of 0.90, differences among grasses were not significant on the second and following days after irrigation to FC. Because of a deeper root system, perennial ryegrass retained its green colour better than the other grasses during dry periods.

- Deficit irrigation to 70% of FC six times per week on greens (average water use per irrigation: 2.4 mm) or two times per week on fairways (6 mm) resulted in consistently better turf quality, fewer dry spots and a reduction in total water use of about 30% compared with deep, infrequent irrigation to FC once per week.
- Use of a soil surfactant improved turf quality on greens and fairways, but the need for surfactants was lower with frequent deficit irrigation than with infrequent irrigation to FC.
- The distribution uniformity (DU) of the irrigation system was determined on selected greens on three golf courses participating in the project. Low DU and the risk of surface runoff imply that it may be difficult to implement daily deficit irrigation without watering by hand.

Photo: Measuring distribution uniformity at Visby GC, Sweden. Note also the surface runoff, which is an important factor regarding water content in the rootzone. Photo: Agnar Kvalbein.

IMPACT OF PRIMO MAXX® AND FUNGICIDES ON TURFGRASS WINTER SURVIVAL ON NORDIC GOLF GREENS

PROJECT PERIOD: AUGUST 2010 – JULY 2013

FUNDING (kSEK)

	2010	2011	2012	2013	Total
STERF					0
Other sources	121	270	486	329	1206
SUM	121	270	486	329	1206

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Tanja Espevig, Bioforsk Turfgrass Research Group, Norway

TALKS AT CONFERENCES, SEMINARS, MEETINGS ETC. IN 2012

12 Nov: Norwegian Golf Federation seminar, Ullevål, Norway
20 Nov: Higher Greenkeeper Education (HGU), Bärsebäck, Sweden
28 Nov: Modern golf course management, Malmö, Sweden
29 Nov: Modern golf course management, Gothenburg, Sweden
30 Nov: Modern golf course management, Stockholm, Sweden

PROJECT SUMMARY AND STATUS AS OF 1 JANUARY 2013

A STERF project from 2007 to 2009 documented less snow mould after use of Primo MAXX® during the previous growing season. The objectives of this project are (1) to further elucidate the effects of Primo MAXX® on turfgrass winter survival and associated characters, and (2) to provide information about optimal use of new fungicides for Nordic golf courses. The project is being carried under the Contract Service Evaluation Agreement between STERF and Syngenta.

Long-lasting ice covers during the winter 2010-11 killed two out of three trials initiated in 2010. The remaining trial suggested less snow mould and better visual merit in spring 2011 on plots that had been treated with PrimoMAXX® in 2010, but the effects were not significant.

The project continued in 2011-12 with a main trial testing Primo MAXX® and fungicides on a *Poa annua* green at Bioforsk Landvik, Norway, and supplementary trials testing fungicides on a *Festuca rubra/A. capillaris*-dominated green at Härmä GC, Finland, and a *Poa pratensis*-dominated fairway at Tegelberga GC, Sweden. In the Norwegian trial, application of Primo MAXX® caused a 31% reduction in turfgrass height growth, a 19% reduction in clipping yield, a 6% increase in green speed, a 7% increase in tiller density and a 15% increase in crown carbohydrate concentration. The latter effect persisted even in the following spring. Negative impacts of Primo MAXX® included a temporary, but significant, reduction in turfgrass colour and an almost significant reduction in turfgrass root depth. All fungicide treatments caused a significant drop in damage by *Microdochium nivale* in autumn and spring, the most efficient treatment being Headway on 13 October, followed by Medallion on 2 and

28 November. Assessment in spring showed an almost significant interaction, as regular use of Primo MAXX® during 2011 caused the strongest reduction in snow mould on plots that had not been treated with fungicides. In the Finnish trial, snow mould infection after 103 days of snow was reduced from an average of 8% on untreated control plots to <1.0% on plots treated with fungicides. The Swedish trial had no snow cover, but the lowest occurrence of *M. nivale* was found on plots that received Headway plus two applications of Medallion.

In 2012-13 the project is continuing with seven new trials evaluating the efficacy of new fungicides against winter diseases on four golf courses in Finland, Sweden and Norway. A first evaluation of Syngenta's Greencast prediction model has been included in the trial at Landvik.

The project is funded 100% by Syngenta and carried out according to the Contract Service Evaluation Agreement between STERF and Syngenta.

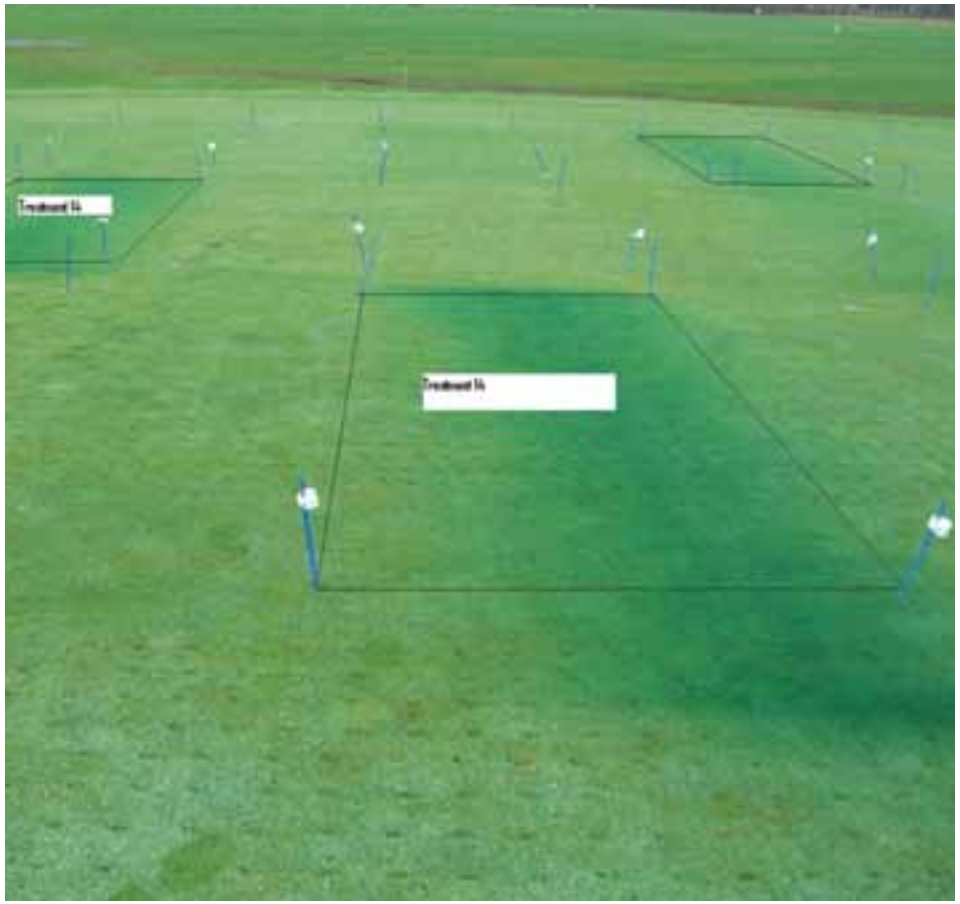

Photo: Some of the fungicides in the 2012-13 trials included turf colorants. This shows the effects on 5 October 2012 at Härma GC, Finland. Photo: Markku Niskanen.

TESTING OF ALTERNATIVE PLANT PRODUCTION PRODUCTS FOR THE CONTROL OF *MICRODOCHIUM NIVALE* AND OTHER DISEASES ON GOLF GREENS

PROJECT PERIOD: OCTOBER 2011 - DECEMBER 2014

FUNDING (kSEK)

	2011	2012	2013	2014	Total
STERF				93	93
Other sources	143	486	415	429	1473
SUM	143	486	415	522	1 566

PRINCIPAL INVESTIGATOR / CONTACT PERSON

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CO-APPLICANTS

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Klaus Paaske, Department of Agroecology, Aarhus University, Denmark
Anne Mette Dahl Jensen, Forest & Landscape, University of Copenhagen-LIFE, Denmark
Lars Wiik, Husec AB, Sweden
Trond Pettersen, Bioforsk Turfgrass Research Group, Landvik, Norway

TALKS AT CONFERENCES, SEMINARS, MEETINGS ETC. IN 2012

2 March: Alternative plant production products for the control of *M. nivale* and other diseases on golf greens. Reference group meeting, Copenhagen:

- Project overview
- Mechanisms and earlier results with biological control of turfgrass diseases
- Preliminary results, Danish trial
- Preliminary results, Swedish trial
- Preliminary results, Norwegian trials
- Plans for in vitro study on the effect of Turf S+ and Turf G+ against *M. nivale*

PROJECT SUMMARY AND STATUS AS OF 1 JANUARY 2013

Directive 2009/128/EG of the EU calls for a reduction in pesticide use by integrated pest management (IPM). One element of IPM is the replacement of pesticides with alternative, non-chemical products. In the Nordic countries, there is a special need for products that control microdochium patch and pink snow mould, both caused by Microdochium nivale.

This project was initiated by the companies: (1) Nordisk Alkali representing the seaweed product Vacciplant from the French manufacturer Göemar, and (2) Interagro BIOS representing the fungal product Turf WPG (*Gliocladium* sp.) and the bacterial product Turf S+ (*Streptomyces* sp.) from the Finnish manufacturer Verdera. Nordisk Alkali and Interagro BIOS received grants from the Danish Environmental Protection Agency and signed contracts with STERF to set up a three-year evaluation project. Testing is primarily being carried out in field trials according to GEP standards, but the microbial products are also being tested in vitro at Bioforsk Landvik, Norway.

Field trials were laid out on greens at Rungsted GC, Denmark, Kävinge GC, Sweden, and Arendal GC and Bioforsk Landvik, Norway, on 19-21 October 2011. Because of delayed contracts, the first applications were conducted 2-3 weeks later than recommended by the manufacturers. Possibly for this reason, and possibly because the microbial products require time to build up an antagonistic microflora, none of the test products showed any significant control of *M. nivale* during the first autumn or winter. Except for the trial at Rungsted, which had to be replaced by a new trial at Sydsjælland GC in June 2012, treatments are now being repeated on the same plots for two more project years. Vacciplant (1.0 or 2.0 l/ha) and Turf WPG (1.0 kg/ha) are applied at four-week intervals from early October to snowfall, followed by two applications after snowmelt coinciding with temperatures of 5 and 10°C in spring. Turf S+ (1.0 l/ha) is applied at four-week intervals throughout the summer, and there is also one treatment that receives both Turf S+ during the summer and Turf WPG during the autumn and early spring. Control treatments in all trials include an unsprayed negative control and a positive control sprayed with fungicides approved for turf in the respective countries.

The first in vitro trial in 2012 showed significant inhibition of *M. nivale* by Turf S+, while the effects of Turf WPG were less consistent and dependent on temperature. This trial will also be repeated in 2013.

The project is funded 100% by Danish Ministry of the Environment , Interagro Bios AB and Nordisk Alkali and carried out according to STERF´s General contract conditions.

Photo (large): Reference group inspecting trial at Rungsted GC, 2 March 2012. Photo: Trygve S. Aamlid.
Photo (small): Equipment ready for application at Arendal GC, 8 November 2012. Photo: Trygve S. Aamlid.

SILVERY THREAD MOSS ON GREENS – PRACTICAL TRIALS WITH IRON, MANGANESE, AMMONIUM CHLORIDE, DETERGENT AND NITROGEN 2011-2013

PROJECT PERIOD: JUNE 2011 – DECEMBER 2013

FUNDING (kSEK)

	2011	2012	2013	Total
STERF	20	20	20	60
Other sources				0
SUM	20	20	20	60

PRINCIPAL INVESTIGATOR / CONTACT PERSON

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CO-APPLICANTS

Hans Karlsson, Ekerum Golf & Resort AB
Henrik Wissinger, Hooks Herrgård AB

TALKS AT CONFERENCES, SEMINARS, MEETINGS ETC. IN 2012

Nov 23: Field day meeting with 80 Course Managers/Greenkeepers in Växjö

PROJECT SUMMARY AND STATUS AS OF 1 JANUARY 2013

We continued with the demonstration experiment that started in summer 2011. The objective is still for the demonstration plots to be treated every 14 days during the period when there is growth at the surface. In 2012 treatments started at the end of May, when growth was well under way, and the plots were treated nine times. Treatment stopped in the middle of November, when the temperature at the surface caused growth above to cease completely.

As in last season, the plots treated with 24 kg iron sulphate showed the best overall visual impression. The plots treated with the wetting agents Ekovett and ammonium chloride (8% solution called Pronto) also showed a good overall impression. Plots treated with 32 kg iron sulphate were heavily stressed and the grass suffered really badly. The area treated with 3 kg N was almost 100% eliminated by snow mould after the previous winter. The areas was reseeded twice this year, but it was extremely difficult to bring that plot into good shape during the season.

There was an increase in soil temperature in the plots treated with iron sulphate. This affected the surface so that was less affected by dew, which was probably a contributing factor to the significantly lower level of fungus in these plots.

Just after the post-season 2011 report, the surface treated with 32 kg iron sulphate was best against moss. The other surfaces had some impact on the moss, but it is difficult to say how much. There is no doubt that good greenkeeping with a lot of needs-driven practices (topdressing, spiking, hollowing, coring etc.) is the best approach.

PRESERVATION OF CULTURAL LANDSCAPES AND CULTURAL HERITAGE ELEMENTS ON GOLF COURSES

PROJECT PERIOD: JANUARY 2009 - APRIL 2013

FUNDING (kSEK)

	2009	2010	2011	Total
STERF	300	300	300	900
Other sources	165	165	165	495
SUM	465	465	465	1 395

PRINCIPAL INVESTIGATOR / CONTACT PERSON

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CO-APPLICANTS

Mari S. Tveit, Helena Nordh and **Gro Koppen**, Dept. of Landscape Architecture and Spatial Planning, Norwegian University of Life Sciences.

PROJECT SUMMARY AND STATUS AS OF 1 JANUARY 2013

This project developed a tool to map visual changes in the cultural landscape, historic elements and public access on golf courses in the northern countries, including the impact of golf courses on cultural landscapes (visual and maintenance); cultural heritage elements on golf courses (perception and maintenance); and public access on golf courses (physical and sociocultural).

Literature studies and case studies in Scandinavia, Iceland, New Zealand and UK were made in the initial phase of the study, as were planning processes and impact assessments in connection with golf course planning.

To develop the mapping tool, existing methods for evaluating cultural landscape, cultural heritage and public access were used. The tool is intended as a help for golf clubs, greenkeepers, golf course architects and authorities when planning or changing golf courses. The mapping tool has been tried out at 8 golf courses in Norway, Sweden, Denmark and Iceland and worked at all of these.

With the suggested adjustments, it is recommended that the tool be digitalised to a dynamic and simple product that it will be accessible for golf clubs and used to collect data for an overall overview in each country.

The principal investigator will examine the possibility of developing such a dynamic product before 1 April 2013. A final project report was delivered to STERF in December 2012.

Photos: 1) Agricultural landscape Maryport GC Cumbria England. 2) Planting on top of bronze age burial site St Michaels GC Scotland. 3) Cycling path and common club house Jacks Point GC Queenstown New Zealand. Photos: O R Sandberg

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EXPERIENCE MAPPING AND MULTIFUNCTIONAL GOLF COURSE DEVELOPMENT - ENHANCED POSSIBILITIES OF INCREASED AND MORE VARIED USE OF GOLF COURSES

PROJECT PERIOD: AUGUST 2011 - JULY 2013

FUNDING (kSEK)

	2011	2012	2013	TOTAL
STERF	267	371	430	1 068
Other sources	138	437	108	683
TOTAL	405	808	538	1 751

PRINCIPAL INVESTIGATOR / CONTACT PERSON

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TALKS AT CONFERENCES, SEMINARS, MEETINGS ETC. IN 2012

15 March: Sydsjællands Golf course, yearly meeting, presentation
19 June: Meeting at Hornbæk golf, Dansk orienteringsforbund
27 Aug: Hornbæk golf, mapping
21 Sept: Hornbæk golf, mapping verification
4 Oct: Sydsjællands golf, meeting
11 Oct: Sydsjællands golf, meeting, Næstved municipality, Local council
23 Oct: Sydsjælland golf, Field day
24 Oct: STERF FOU meeting Copenhagen
22 Nov: Viksjø golf course, Field day
23 Nov: Viksø golf course, STERF workshop, presentation

PROJECT SUMMARY AND STATUS AS OF 1 JANUARY 2013

The demand for strengthening the multifunctional use of golf courses is the scientific frame for this project, aiming at integrating and enhancing ecosystem services and recreational functions. As golf courses have traditionally been seen as a "single" land use by users (golf players), knowledge about attitudes to more multifunctional land use on golf courses is limited.

The project is adapting and refining a method for mapping existing and potential experiences into an operational tool that can distinguish between seven experience values and designate unused potentials that can be utilised and further developed, which is likely to attract new users. Overall, the project seeks to strengthen the ecological and recreational footprint provided by golf courses and also contribute to their economic sustainability. Benefits from this project for golf clubs might result in more players and also a possible collaboration with other users, which in the end might strengthen the economy in golf clubs.

During 2012 mapping of recreational experiences was carried out at three golf courses. At Hornbæk golf course, the project co-operated with the Danish Orienteering Federation and the Danish Outdoor Council, which resulted in a multifunctional development of the golf course including specific trails, signs and information for users. At Sydsjællands golf course, the focus was on the recreational interconnection of the golf course and the surroundings. The location of the golf course on the outskirts of the city of Mogenstrup facilitates multifunctional use that involves local organisations and the municipality. Hence the project is contributing to an interactive

and inclusive planning procedure that comprises the golf course and the local society. The mapping procedure includes the neighbourhood within a distance of 2 km from the golf course. The mapping of recreational experiences at this location is being used as background information in the forthcoming planning of new recreational trails in the area.

Viksjø golf course was visited in late November 2012 and the mapping procedure of experience values was started. The golf course is located in one of the green wedges on the urban fringe of Stockholm and there is already good access to the golf course for non-golfers. However, information regarding ecological and cultural values could be improved, so this issue will be included in a proposal for future development. During 2012 the project participated in the STERF workshop in Viksjø, and established contacts with organisations and the municipalities responsible for the two Danish golf courses. The progress of the project has been delayed, and a revised plan for 2013 has been developed.

Photo: A group of women pole walking at Sydsjaellands GC. Photo: Ole Hjorth Caspersen

INTERACTIVE MAP WITH NAVIGATION TO LEARN AND UNDERSTAND ENVIRONMENTAL WORK AND IMPACT AT A GOLF COURSE

PROJECT PERIOD: JUNE 2011 – DECEMBER 2012

FUNDING (kSEK)

	2011	2012	Total
STERF	45	5	50
Other sources		50	50
SUM	45	55	100

PRINCIPAL INVESTIGATOR / CONTACT PERSON

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The project was conducted by the Environmental Committee, Saltsjöbaden Golf Course.

CO-APPLICANTS

Jonas Fejes, IVL Swedish Environmental Research Institute
Magnus Olofsson, Greenkeeper, Saltsjöbaden Golf Course

TALKS AT CONFERENCES, SEMINARS, MEETINGS ETC. IN 2012

15 April: Presentation for Nacka municipality. Swedish title: 'Saltsjöbadens Golfklubb. Så arbetar vi med miljö och hållbar utveckling'
20 Aug: Presentation for the Board of the Saltsjöbaden golf course.
1 Nov: Presentation for a number of Swedish golf courses. Swedish title: 'Saltsjöbadens Golfklubb. Så arbetar vi med miljö och hållbar utveckling'

PROJECT SUMMARY AND STATUS AS OF 1 JANUARY 2013

In June 2011, the Environmental Committee at Saltsjöbaden GC received a research grant from STERF. The objective of the project "Interactive map to learn and understand environmental work and impact at a golf course" is to stimulate and encourage golf clubs to conduct structured and effective environmental work and, as a result of this, inform and communicate the work with stakeholders in an accessible, educational and easy way. Stakeholders are both internal (members, board and employees) and external (e.g. green fee players, authorities, neighbours, etc.). By using interactivity, linked to the golf club's home page, a prototype for this navigation has been developed, to inform about environmental work and impact.

There are many ways of doing this. The most common way is to develop a clickable home page, where the user decides which information is of interest. To develop such an interactive home page a web tool is needed. In the project, we have tested some different web tools for generating interactive presentations and some programming languages for home pages. All are more or less complicated to use and often need regular usage of the program to remember how to do things. We concluded that we need a simple platform to which we can add the environmental information. The platform that met most of the criteria we set was Google Maps. Google is a well-established company, working on the principle that everything should be free of charge for the user. Google has developed the map tool Google Maps, which is now is loaded in almost every PC and/or smart phone. Google Maps includes a comprehensive search tool and also a tool for every user, to publish their own information on maps and sha-

re it with others. This tool is useful for environmental information from golf clubs, since we prefer to illustrate environmental data on maps (spatial). Our users, e.g. golfers, are also very familiar with maps, at least with course guides and other types of map tools, e.g. to measure distances. Google Maps is regularly updated and new functions are added now and then. The information added from the golf club can be published on both Google Maps and Google Earth.

By using Google Earth, the members/users can publish their own photos from the area and thereby participate in developing the 'information database'. In the future, it may also be possible to 'walk' the golf course in Google Earth and see the course in 'street view'. We will contact Google and suggest they develop 'street view' images of the Saltsjöbaden golf course. If you are interested in seeing the Saltsjöbaden golf course in Google Earth, use the link below, click KML, and open the link at the left bottom corner. Then use your mouse and point to the different parts of the course; back tee, front tees, fairway, green, bunker, etc. or the symbols on each course.

http://maps.google.se/maps/ms?vps=2&hl=sv&ie=UTF8&oe=UTF8&msa=0&msid=204684366051337756305.0004cf022e93036278605

Illustration: The platform for the interactive map is developed by using specific information from the second hole on Saltsjöbaden Golf Club, Sweden.

INTEGRATED PEST MANAGEMENT - COMMUNICATION PROJECT WITHIN THE PARK AND GOLF SECTOR

PROJECT PERIOD: APRIL 2011 – MARCH 2012

FUNDING (kSEK)

	2011	2012	TOTAL
STERF	100		100
Other sources	309		309
TOTAL	409		409

PRINCIPAL INVESTIGATOR / CONTACT PERSON

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CO-APPLICANTS

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Arne Tronsmo, Universitet för Miljö and Biovetenskap
Paula Persson, SLU
Peter Edman, Svenska Golfförbundet
Martin Nilsson, Danish Greenkeeper Association

PROJECT SUMMARY AND STATUS AS OF 1 JANUARY 2013

European Parliament and Council Directive 2009/128/EG of 21 October 2009 contains regulations establishing a framework for achieving sustainable use of pesticides. This will be done for example through the application of integrated pest management (IPM). The Directive can increase the opportunities to increase competencies within Nordic golf course management in the long term, e.g. through IPM. One condition for this is that training, advisory work and R&D associated with the Directive have content that is relevant for the golf sector.

STERF can contribute to competence development within integrated pest management for the park and golf sector in the Nordic countries by communicating new knowledge and tested experience in an IPM perspective. In order to prepare the park and golf sector for the challenges contained in the new EU Directive, STERF has developed a digital reference library on IPM. This will also act as important teaching material within training programmes organised by actors in the park and golf sector and the general education system. In addition, it can be used in the planned skills training courses within the park and golf sector.

The aims of the project were to:

- Contribute to achievement of the environmental quality objective 'Toxin-free environment' through increasing competencies within IPM for the park and golf sector.
- Contribute to efficient implementation of the EU Directive on sustainable use of pesticides through increasing competencies within IPM for the park and golf sector.
- Contribute to more efficient management of golf courses and other grassed recreation areas through providing a better knowledge base that can be used to analyse the effects of different management methods and as data support in decisions on changes in management routines.

- Utilise communal Nordic experience to make the Nordic countries a model region within IPM for the park and golf sector
- Increase the use of digital information and training material

The project has delivered:

- A digital reference library on integrated pest management (IPM site) where fact sheets, frame description and other training material are available and where current R&D projects are presented. This is part of the STERF website. The material on the IPM site will be translated into Danish, Norwegian, Icelandic and English.
- 18 central fact sheets presenting existing knowledge and tried and tested experience on ongoing and completed STERF projects, other relevant R&D projects, practical golf course management and relevant knowledge and experience from neighbouring sectors, e.g. agriculture, in an IPM perspective. These fact sheets focus on the following subject areas: Choice of grass species for Nordic conditions, control of diseases, weeds and insects of relevance for maintenance of green areas, optimal irrigation and fertilisation in order to create a grass plant that is tolerant to disease and can compete with weeds, recommendations for good overwintering and control of thatch.
- A brief framework description of what IPM means for the park and golf sector. This is based on Nordic and international experiences and experiences within neighbouring sectors.
- A steering group for competence development within IPM for the park and golf sector in order to ensure that communal Nordic experience is utilised for future continuous expansion of competences.

Illustrations: The fact sheets (top) can be found on the IPM webb site at sgf.golf.se (bottom).

COMPLETED PROJECTS

The projects listed below were funded by STERF during the period 2001-2011. More information about the projects can be found on the STERF website **sterf.golf.se**

1. **Nitrogen utilisation efficiency in different golf green constructions of Creeping Bentgrass golf greens.** Karin Blombäck, Swedish University of Agricultural Sciences (2001-2004).

2. **Effects of demand-driven fertilisation on growth, appearance and nitrogen use efficiency of turfgrass.** Tom Ericsson, Swedish University of Agricultural Sciences (2003-2004).

3. **Leaching of fungicides from golf greens: Quantification and risk assessment.** Nicholas Jarvis, Swedish University of Agricultural Sciences (2004-2005).

4. **Benefits and environmental risks of fungicide use on Scandinavian golf greens**. Trygve S. Aamlid, Norwegian Institute for Agricultural and Environmental Research (2004-2005).

5. **Evaluation of Agrostis and Festuca varieties for use on Scandinavian golf greens.** Trygve S. Aamlid, Norwegian Institute for Agricultural and Environmental Research (2004- 2007).

6. **Evaluation of Agrostis and Festuca varieties (Nordisk sortguide).** Trygve S. Aamlid, Norwegian Institute for Agricultural and Environmental Research (2007).

7. **Evaluation of biodiversity and nature conservation on golf courses in Scandinavia.** Bente Mortensen, GreenProject (2006-2007).

8. **Effects of organic amendments and surfactants on hydrophobicity and fungicide leaching from ageing golf greens**. Trygve S. Aamlid, Norwegian Institute for Agricultural and Environmental Research (2006-2007).

9. **The role of golf course management in the support of wetland-associated organisms in greater metropolitan Stockholm.** Johan Colding, Beijer Institute of Ecological Economics, Royal Swedish Academy of Science (2006-2008).

10. **Ageing of a sand-based rootzone.** Karin Blombäck, Swedish University of Agricultural Sciences (2006-2008).

11. **Turfgrass demonstration trials in Dalarna.** Erik Svärd, Swedish Golf Federation (2006-2008).

12. **Improved strategy for control of *Microdochium nivale* on golf courses.** Anne Marte Tronsmo, Department of Plant and Environmental Sciences, Norwegian University of Life Sciences (2006-2008).

13. **The influence of golf on nature and environment – analyses and evaluation of the environmental performance in Scandinavia.** Bente Mortensen, GreenProject (2006-2008).

14. **Evaluation of the plant growth regulator trinexapac-ethyl (Primo MAXX®) on Nordic golf courses.** Trygve S. Aamlid, Norwegian Institute for Agricultural and Environmental Research (2007-2009).

15. **Development, evaluation and implementation of playing quality parameters in a continuous golf course evaluation concept – user survey.** Anne Mette Dahl Jensen, Forest & Landscape, University of Copenhagen (2007-2009).

16. **Re-establishment of green turfgrass after winter damage, spring 2009**. Agnar Kvalbein, Norwegian Greenkeepers' Association (2008-2009).

17. **Impact of mowing height and late autumn fertilisation on winter survival of golf greens in the Nordic countries.** Agnar Kvalbein, Norwegian Greenkeepers' Association (2008 -2010)

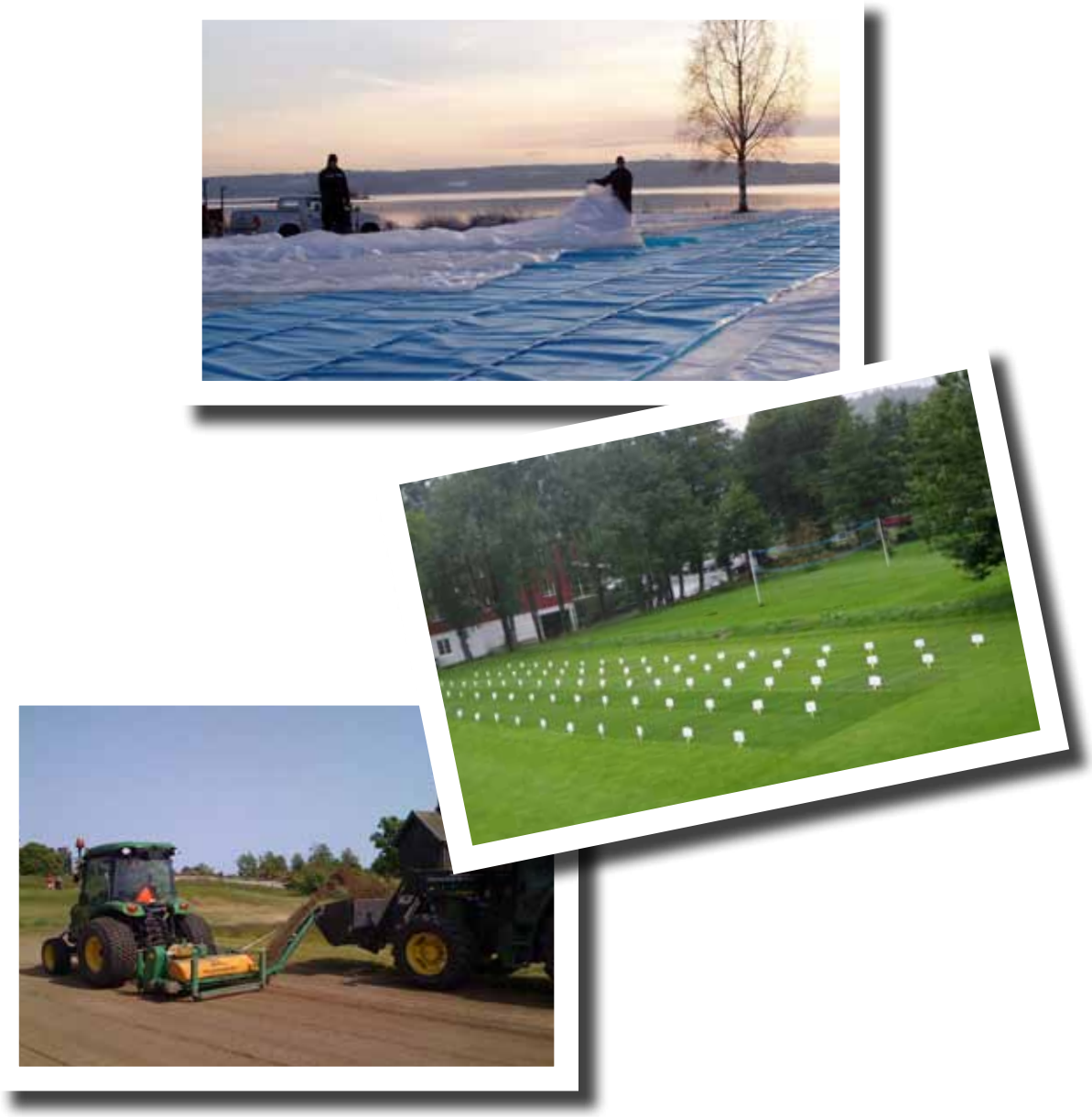
18. **Multifunctional golf course with unique natural and cultural values.** Carina Wettemark, Kristianstads Vattenrike Biosphere Reserve, Kristianstads kommun (2008 – 2010)

19. **Evaluation of turfgrass varieties for use on Scandinavian golf greens, 2007-2010.** Trygve S. Aamlid, Norwegian Institute for Agricultural and Environmental Research (2007-2010)

20. **Demonstration trials with winter cover protection.** Boel Sandström, Swedish Golf Federation (2007-2010)

21. **VELVET GREEN: Winter hardiness and management of velvet bentgrass (*Agrostis canina*) on putting greens in northern environments.** Tatsiana Espevig, Norwegian Institute for Agricultural and Environmental Research (2007-2011)

22. **Fertiliser strategies for golf turf: Implications for physiology-driven fertilization.** Tom Ericsson, Department of Urban and Rural Development. Swedish University of Agricultural Sciences. (2007- 2011)



STERF KEY INDICATORS 2006 - 2012

The key indicators are based on information in project annual reports. STERF issues an open call for proposals approximately every two years. However, if there are specific reasons, a project application in between open calls for proposals may be approved for funding by the STERF board.

Year	Funding	Applications received	Applications approved for funding	Ongoing projects	Scientific publications	Popular publications	Presentations at seminars, conferences, etc.	Handbooks Fact sheets Programmes
2006	1 500 000 SEK	17	7	12	7	23	46	
2007	4 900 000 SEK	1	1	13	3	12	26	1
2008	4 500 000 SEK	22	6	16	11	29	42	2
2009	5 500 000 SEK	1	1	15	16	20	49	1
2010	3 000 000 SEK	16	9	13	7	29	46	1
2011	3 700 000 SEK			19	4	32	50	25
2012	3 400 000 SEK			18	21*	24	98	25

* : Peer-reviewed papers = 9, Publications and reports = 12

FINANCIAL SUMMARY

INCOME STATEMENT	01/01/2012 12/31/2012	01/01/2011 12/31/2011
Revenue		
Net revenue	4 609 243	4 468 168
	4 609 243	4 468 168
Expenses		
Other external expenses	-21 039	-4 344
	4 588 204	**4 643 824**
Income from financial items		
Interest	51 507	58 011
Surplus	**4 639 711**	**4 701 835**

BALANCE SHEET		12/31/2010
Other receivable	0	0
Cash and bank balances	4 887 342	3 787 832
Total assets	**4 887 342**	**3 787 832**
Liabilities and equity		
Equity		
Restricted reserves	260 840	258 265
Non restricted reserves	4 626 502	3 524 567
Total equity	**4 887 342**	**3 782 832**
Current liabilities		
Other current liabilities	0	5 000
Total current liabilities	**0**	**5 000**
Total liabilities and equity	**4 887 342**	**3 787 832**

LIST OF PUBLICATIONS

Aamlid, T.S. 2003. Kraftig satsing på golfgras i Planteforsk. Gressforum 2003 (3)2: 24-25.

Aamlid, T.S. 2003. Prøving av kvein- og rødsvingelsorter på golfgreen. Park & anlegg 2(4): 14-16.

Aamlid, T.S. 2003. Nye forsøksgreener på Landvik for måling av utvasking av gjødsel og plantevernmidler. Gressforum 2003 (3): 28-29.

Aamlid, T.S. 2004. Nye forsøksgreener på Landvik. Park & anlegg 3 (7): 14-17.

Aamlid, T.S., B. Molteberg, M.E. Engelsjord & K.O. Larsen 2003. Evaluation of *Agrostis* and *Festuca* varieties for use on Scandinavian golf greens. Results from the sowing year 2003. Report to the Scandinavian Turfgrass Research Foundation. 19 pp.

Aamlid, T.S. & B. Molteberg 2004a. Evaluation of *Agrostis* and *Festuca* varieties for use on Scandinavian golf greens. Results from the sowing year 2003 and first green year 2004. Report to the Scandinavian Turfgrass and Environment Research Foundation. Sterf.golf.se 24 pp.

Aamlid, T.S. & B. Molteberg 2004b. Utprøving av grasarter og –sorter på golfgreener. Resultater fra green-forsøka på Landvik og Apelsvoll i såingsåret 2003. Gressforum 1/2004: 18-21.

Aamlid, T.S., B. Molteberg & A. Tronsmo 2004. Norske gras sorter på norske golfbaner. Gressforum 2/2004: 20-23.

Aamlid, T.S. & B. Molteberg 2005. Klare forskjeller i overvintring og tidspunkt for vekststart på Planteforsks forsøksgreener. Gressforum 2/2005: 18-21.

Aamlid, T.S., B. Molteberg, F. Enger, Å. Susort, Å. & A.A. Steensohn 2005a. Evaluation of *Agrostis* and *Festuca* varieties for use on Scandinavian golf greens. International Turfgrass Society Research Journal 10: 52-53.

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