Proposal to the Scandinavian Turfgrass and Environment Research Foundation (STERF)

Overseeding of Fairways

- A strategy for finer turf with less broadleaved weeds and *Poa annua*

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Summary

Research concerning management of golf course fairways has so far been neglected compared to golf greens. Legislations 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. Today, most knowledge regarding overseeding is related to Bermuda grass fairways in the USA. Therefore, more information regarding the optimal overseeding strategy in the Nordic countries is crucial in order to create a strong fairway with a minimum of *Poa annua* and broadleaved weeds.

The aim of the project is to test a variety of parameters that influence the outcome of an overseeding procedure. This includes overseeding date, fertilisation and turfgrass species.

Tests will be performed on an experimental fairway at Landvik (Bioforsk, Norway) and on 3 golf courses in Denmark for the period 2011-2013 and with registrations in 2014. Registration will be on grass species composition and on weed occurrence (covering degree of the different weed species). Additionally the economical costs of the different procedures will be estimated for a standard golf course.

The results of the project will be used to create guidelines on how to establish a competitive grass cover on fairways by implementing an overseeding program. These guidelines can be used directly by golf clubs and greenkeepers in order to evaluate an overseeding strategy – effect and cost.

Project period

1. April 2011 – 31 December 2014

Project description

Background

The EU legislation regarding pesticide use, the Danish pesticide agreement, and a more extreme climate will create many challenges on the golf courses. Most focus has been on greens but serious problems will occur also on fairways. More and more broadleaved weeds are seen as herbicide use is decreased. The Danish experience so far is that many courses can cope with the weeds for 3-4 years after an herbicide ban is introduced, but then problems escalate to levels severely reducing not only the aesthetic quality, but also the playing quality (ball lie) on the fairways. Unfortunately, experiences from an on-going STERF project do not indicate that the weed problem can be controlled by mechanical treatments alone.

Another, just as serious problem, is the encroachment of *Poa annua* on fairways. This problem seems to increase with increasing pressure from players (longer seasons, more golf rounds), heavier machinery and warmer, wetter and less stable winters due to climate change. Among the consequences of this encroachment is less drought tolerance in summer, more physical winter damage and more diseases, especially *Microdochium nivale*. Since fairways make up such a high proportion of the total golf course area, a complete strategy for less pesticide use and integrated pest management on golf courses must include fairways, not only the greens and tees.

Fairway overseeding is a management technique not often used in the Nordic countries. It might, however, be the solution, or at least part of the solution, to the broadleaved weed and *Poa annua* problems. This management technique helps to replace unwanted grasses, or it is used as at strategy to improve recovery after intense wear. Overseeding is also important for introduction of new and improved species/varieties into the turf. Improved characters can be improved disease resistance, better drought tolerance, higher shoot density etc.

Most scientific data on fairway renovation by overseeding comes from the transition zone in the USA where Bermuda grass fairways are often overseeded with rough bluegrass (*Poa trivialis*), annual ryegrass (*Lolium multiflorum*) or perennial ryegrass (*Lolium perenne*) (Morris, 2004; McCarthy, 2009). A quick search in the American turfgrass information database showed 120 references with the combination of ‘fairway’ and ‘overseeding’ in the title, however, more than 100 of these references were related to optimal use of pesticides or chemical growth regulators during the overseeding process. A single experiment from the UK demonstrated a pronounced effect of overseeding (Harris, 2008). Observations on Viborg Golf Course, Denmark, showed a conspicuous effect of overseeding. Even ten years after a large-scale demonstration trial was finished, plots which included overseeding had more perennial grasses and less weeds compared to plots with no overseeding (Nyholt, 2010).

Turfgrass species and varieties for overseeding

The choice of turfgrass-species for overseeding is mainly determined by the climatic zone and based on the initial species composition. Fairways in the Nordic countries are primarily established with red fescue (*Festuca rubra* spp.) or a mixture of red fescue, perennial ryegrass and Kentucky bluegrass (*Poa pratensis*). A few courses have established American-style fairways with creeping bentgrass (*Agrostis stolonifera*).

So far, only a few Danish courses have included overseeding of fairways in their management plan. Most of them do it only sporadically and infrequently. Red fescue, Kentucky bluegrass and perennial ryegrass are used for overseeding in different mixture combinations.

Using Kentucky bluegrass for overseeding is questionable because it does not establish easily in a mixture (Larsen et al., 2004). This species has a poor establishment compared to red fescue and perennial ryegrass due to a larger thermal time required for germination (Larsen and Bibby, 2005). But the species is wanted on fairways due to its high recuperative capacity. Many new cultivars that tolerate mowing heights down to 12 mm are now coming to the market (Molteberg and Aamlid, 2007).

Some courses favour red fescue as the overseeding grass species; however perennial ryegrass might be an option, too. Ryegrass germinates faster and has better shoot and root competition against weeds. This also includes competition for nitrogen (Haugland and Froud-Williams, 1999). Increasing the amount of ryegrass degreases the dry weight of voluntary seedlings such as *Poa annua* (Snaydon and Howe, 1986). Root competition is generally very important between established species and seedlings (Jeangros and Nösberger, 1990). Perennial ryegrass may be a good competitor in relation to *Poa annua* and other weeds.

Red fescue is a reasonable choice if a course wants to reduce input such as fertilizer on fairways. However, unlike Kentucky bluegrass, and to a certain extent perennial ryegrass, red fescue has little seed dormancy, and must therefore be seeded every year.

The effect of overseeding varies. Generally it is difficult to achieve an efficient establishment of the sown species because the new seedlings must compete with the established sward (Henriksson, 1991). To enhance the effect of overseeding the seed must come in contact with the soil. The seed must be placed in the growing layer and the grass must be sown when annual bluegrass (*Poa annua*) and broadleaved weeds species that dominate on golf fairways have a reduced growth rate. (Vargas and Turgeon, 2004) Some of the factors that might affect the outcome of the overseeding are time of seeding and the amount of fertilizer.

The most important fertilizer component in the establishment phase is phosphorous (McVey, 1968). It is immobile and in order for the small seedling with a limited root volume to be able to get in contact with it, there must be a fairly large amount of phosphorous in the soil. In contrast, the nitrogen level must not be too high because it can burn the small seedlings (Christians, 2007). When the seedlings are established the grass need N for further growth. In Denmark the average amount of fertilizer used on fairways is approx. 50 kg N /ha/ year. This might be too low in order to provide the desired grass species with a satisfactory growth and the ability to compete with broadleaved weeds.

The dominant weed grass on fairways is *Poa annua*. Populations of this weed on golf courses are morphological and physiological different in relation to origin (green, fairway or rough). This includes differences in germination and flowering (Lush, 1989). *Poa annua* populations from less managed areas (rough and fairway) have a lower germination ability at high temperature (25 °C, Wu et al., 1987). Additionally an examination of *Poa annua* ecotypes demonstrated that all ecotypes germinated to some degree in complete darkness, which indicates that maintaining a dense turf canopy to eliminate annual bluegrass germination may not be completely effective. This justifies the focus on overseeding and timing in order to obtain detailed information about *Poa annua* occurrence and fairway density.

Overseeding fairways might present a budget problem for many golf clubs, especially if the overseeding program includes topdressing and irrigation. It is a standard procedure on greens and tees, however, these areas usually cover less than 5% of the total course area. Overseeding fairways is a larger operation that includes around 20 % of the course area. Therefore, a complete overseeding program will have an impact on the golf clubs maintenance budget (man hours, equipment, seed, etc). Evaluation of costs for the overseeding programs is therefore of large interest.

Objective

- To evaluate the impact of time, turfgrass mixture and fertilization practises when overseeding fairways on Nordic golf courses
- To conduct a cost calculation of different overseeding programs

Hypothesis

- There will be less dicot weeds and *Poa annua* by frequently overseeding fairways on Nordic golf courses
- Increasing the amount of fertilizer used on fairways will increase the covering degree of desirable grasses and reduce the amount of broadleaved weeds
- Using perennial ryegrass will result in the fastest improvement in fairway quality, however, after two years of repeated overseeding , the effects of red fescue and Kentucky bluegrass will also become significant

Research methodology

This proposal includes a three- year field trial at Bioforsk Landvik in Norway and field trials on three golf courses in Denmark (Korsør, Skovbo and Hornbæk). Within the budget limitations it is impossible to include additional courses in northern Scandinavia. Registrations will be expensive as well as transportation of experimental equipment. Additionally it is complicated to transport turf/soil samples back to Denmark for analysis. To include only one northern golf course might also produce misleading results. To draw definite conclusions for the northern climatic zone of Scandinavian would require three additional experiments.

The trials at the three Danish golf courses will be coordinated with the large scale demonstration project “Ukrudt control på fairways”. A slit sowing equipment is used in both projects (the project part that takes place on golf courses) which make a comparison of results more reasonable. Additionally the same fertilizer levels will be used in both projects when it comes to nitrogen. Another commonality is that the large scale project uses a seed mixture of the same three species that we use in our project. However, in our project, the species will be sown separately as this will produce more information and facilitate scientific publication of results.

Seed blends will be selected in collaboration with Prodana, which is sponsor of the project. Seed blends of Kentucky bluegrass and perennial ryegrass will be composed of three of the most highly-ranked varieties of each species. The seed blend of red fescue will contain two highly-ranked varieties of each subspecies.

The experimental treatments will be implemented in 2011, 2012, 2013, and the collection of data completed in 2014.

Landvik trial

In the small-scale trial at Landvik, conditions for establishment of the overseeded grasses will be optimized to study the colonization potential of the various species and also the effect of additional fertilizer when water is not a limiting factor. The trial will be conducted on an experimental fairway seeded in 2003 on a silt loam soil (64% sand, 29% silt, and 7% clay) with a seed mixture based on available seed of red fescue, Kentucky bluegrass and colonial bentgrass. Partly because varieties were not selected very carefully, and partly because the fairway has never been overseeded, the turfgrass cover is now dominated by *Poa annua*
The following experimental treatments will be compared:

1. No overseeding, no additional fertilizer
2. No overseeding, additonal application of 50 kg N/ha when overseeding around 1 May
3. No overseeding, additonal application of 50 kg N/ha when overseeding around 1 Sep

4. Seeding of red fescue around 1 May, no additional fertilizer
5. Seeding of red fescue around 1 May, additonal application of 50 kg N/ha when overseeding
6. Seeding of Kentucky bluegrass around 1 May, no additional fertilizer
7. Seeding of Kentucky bluegrass around 1 May, additonal application of 50 kg N/ha when overseeding
8. Seeding of perennial ryegrass around 1 May, no additional fertilizer
9. Seeding of perennial ryegrass around 1 May, additonal application of 50 kg N/ha when overseeding

10. Seeding of red fescue around 1 Sep., no additional fertilizer.
11. Seeding of red fescue around 1 Sep., additonal application of 50 kg N/ha when overseeding
12. Seeding of Kentucky bluegrass around 1 Sep., no additional fertilizer
13. Seeding of Kentucky bluegrass around 1 Sep., additonal application of 50 kg N/ha when overseeding
14. Seeding of perennial ryegrass around 1 Sep., no additional fertilizer
15. Seeding of perennial ryegrass around 1 Sep., additonal application of 50 kg N/ha when overseeding

The standard fertilizer program on the experimental fairway is 50 kg N/ha, split between three applications of granular fertilizer (Fullgjødsel 22-2-12 or OPTI-NK 22-0-12) per year. The additional fertilizer at seeding in half of the treatments will be given in the form of Sierraform Preseeder GT 18-22-5 containing about 50% slow-release nitrogen and also ensuring P to the developing seedlings.

To facilitate detailed studies on botanical composition, plot size in the trial at Landvik will be limited to 1 m x 2 m. The experiment will have four replicates (blocks).

Overseeding will be conducted according to the following procedure:

- Mowing height during the last week before overseeding will be reduced from the usual 15 mm to 10 mm to reduce competition from *Poa annua*
- The entire plot will be hollow-tine cored to 4 cm depth using a walk-behind JD Aerocore, 1 m wide and with 12 mm pipes. Cores will be removed with an air-blower
- Exact seeding and application of additional fertilizers will be conducted using a Scot's drop spreader, 1 m wide. The sowing rate of all species will equal 3 kg per 100 m2. This amount is chosen for all three species mixtures and the equal amount compensate for differences in field germination potential for the different species
- Seed and/or fertilizer will be raked or blown into the holes. The entire main plot will be top-dressed with pure sand, 5 kg/m2 and the sand brushed into the holes
- Mowing will be suspended for one week after seeding
- The trial will be irrigated after seeding and the irrigation amount recorded

A slit seeding machine is not used in the trial in Norway. It is not possible to use this equipment in the small plots.

Registrations

- Precipitation and temperature is automatically on a daily basis throughout the year.
- Soil temperature will be measured at sowing and once per week during the two following weeks. Visual recordings of turfgrass overall impression, tiller density, coverage, diseases every month throughout the project period.
- Fairway tiller density and botanical composition / the amount of weed prior to seeding in spring 2011, and then on 15 October in 2011-2014.

Trial at 3 Danish golf courses

In the Danish fairway trials the colonization potential of the various species and also the effect of additional fertilizer will be studied under "real" fairway overseeding conditions with no additional water and no topdressing.

The trials will be conducted on natural soil on established golf course fairways of different age, with different grass species composition (much *Poa annua*) and differences in weed covering degree.

The following experimental treatments will be compared:

1. No overseeding, no additional fertilizer
2. No overseeding, additional application of 50 kg N/ha when overseeding around 1 May
3. No overseeding, additional application of 50 kg N/ha when overseeding around 1 Sep

4. Seeding of red fescue around 1 May, no additional fertilizer
5. Seeding of red fescue around 1 May, additional application of 50 kg N/ha when overseeding
6. Seeding of Kentucky bluegrass around 1 May, no additional fertilizer
7. Seeding of Kentucky bluegrass around 1 May, additional application of 50 kg N/ha when overseeding
8. Seeding of perennial ryegrass around 1 May, no additional fertilizer
9. Seeding of perennial ryegrass around 1 May, additional application of 50 kg N/ha when overseeding

10. Seeding of red fescue around 1 Sep., no additional fertilizer
11. Seeding of red fescue around 1 Sep., additional application of 50 kg N/ha when overseeding
12. Seeding of Kentucky bluegrass around 1 Sep., no additional fertilizer
13. Seeding of Kentucky bluegrass around 1 Sep., additional application of 50 kg N/ha when overseeding
14. Seeding of perennial ryegrass around 1 Sep., no additional fertilizer
15. Seeding of perennial ryegrass around 1 Sep., additional application of 50 kg N/ha when overseeding

The standard fertilizer program on the experimental fairway is 50 kg N/ha, split between two applications of granular fertilizer (Mastercare 15-3-12) per year (spring and fall). The additional fertilizer at seeding in half of the treatments will be given in the form of Higreen 16-11-18 containing more P to ensure the developing seedlings.

Soil analysis (texture, organic matter and chemical composition) will be carried out in spring 2011 in order to evaluate the P value. The composition of fertilizer (the P amount) will be based on that analysis. Additionally the analysis will define the soil types on the experimental site (golf course fairways).

Plot size in the trials at three Danish golf courses will be 2 m x 15 m. The experiment will have four replicates (blocks).

Overseeding will be conducted according to the following procedure:

- Seeding of subplots will be conducted using a BLEC Disc Seeder 1800 (Working width 1,8m, 5 cm between each slit). The machine is provided by Prodana and can be used throughout the whole experiment. Sowing rate of all species will equal 3 kg per 100 m2. This amount is chosen for all three species mixtures and the equal amount compensate for differences in field germination potential for the different species
- Fertilizer will be spread on subplots using equipment available at the golf course
- There will be no topdressing and no irrigation on fairways during the growing season
- Fairways at the 3 golf courses will be mowed according to normal practise on each course

Registrations

- Precipitation is registered electronically or manually by the greenkeepers on a weekly basis
- Temperature registrations are collected from the Danish Meteorological Institute

- Soil temperature will be measured when overseeding is performed in May and September (one measurement in each plot)
- Rounds of golf on each golf course will be estimated based on data from the participating golf clubs
- Soil analyses; chemistry, texture, and organic content will be performed just before the first treatment in may 2011
- Botanical composition will be made prior to seeding in spring 2011 and then each year in October. Small cores from each plot are collected, placed in the greenhouse for approx 2 weeks and then number of plants (on species level) is counted
- The amount of weed will be estimated prior to seeding in 2011 – spring and fall and again in 2012, 2013 and 2014 spring and fall. Registration is performed on the course using a counting frame (5 counts in each plot)
- Number of turf marks will be measured each time treatments are performed
- The total cost of overseeding will be calculated (fertilisation, equipment, equipment maintenance, fuel, man-hours, etc)

Statistical analyses

Data from the trials at Landvik and in Denmark will be subjected to statistical analyses.

Dissemination of results

- By the end of each growing season, preliminary results will be presented to STERF
- The project will be presented in Gressforum (N), Greenbladet (S), Greenkeeperen (DK) in 2011. Results will be popularised and disseminated, through articles in Gressforum (N), Greenbladet (S), Greenkeeperen (DK) in 2014
- In fall 2014 there will be one field day at Landvik and one field day in Denmark
- By the end of the project a paper with the working title 'Overseeding of fairway – A strategy for finer turf with less broad-leaved weeds and Poa annua?" will be submitted to an international peer-reviewed turfgrass journal
- Project information will be available on Turfgrass.dk

Project group

- Anne Mette Dahl Jensen, Forest & Landscape, Denmark
- Trygve Aamlid, Bioforsk, Norway
- Head greenkeeper, Hornbæk golf club, Denmark
- Head greenkeeper, Skovbo golf club, Denmark
- Head greenkeeper, Korsør golf club, Denmark

The project group will meet every year

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