

Royal Copenhagen Golf Club

Sustainable Agronomy Report

Report by Alistair Beggs

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ROYAL COPENHAGEN GOLF CLUB AGRONOMY REVIEW

Club Representatives

R&A

Martin Nilsson - Course Manager

Christian Thge Hansen-General Manager Alistair Beggs – Head of Sustainable Agronomy

Overview

- This visit represents the first by the author since 2018 and as such provided a good opportunity to measure progress made in this period, which includes the Covid pandemic years when use and inputs to the site were much reduced.
- The course remains a superb example of pesticide free management in Europe and Martin and and his team are proving that high standards can be produced without resorting to chemical solutions to manage turf. However, this often necessitates creative thinking to solve problems and does mean compromises in standards in some areas e.g. 1st and 18th greens, where disease pressures are that bit greater because soil types and environmental conditions are less conducive to growing the more sustainable grasses.
- Greens are generally in good order and are putting well. The mixed swards reflect the wider environment with desirable fescues prevalent on most greens alongside bents, rye and meadow grass. Further progress needs to be made to blend these grasses together to provide a surface earlier in the season and this may require more feeding alongside verticutting, grooming and brushing. The 1st and 18th greens are noticeably weaker and diseased. These surfaces suffer due to a poorer growing environment and it is difficult to see them improving significantly unless this changes (more air and light).
- The use of iron sulphate to control white clover contamination continues to work well and whilst the weed is present it is not impacting too greatly on ball roll or aesthetic qualities.
- Profiles beneath greens are good in all cases and greens are benefitting from a consistent dressing programme and good aeration programmes. As lab results confirm, organic matter levels are within the ranges we seek. Minor adjustments to fertiliser inputs are required most notably applying more nitrogen in the spring to allow for stronger growth and earlier refinement.
- Green surrounds are also cleaner of clover and present better as a result. The same strategy is used here. The main challenges are controlling coarse rye contamination on approaches and better managing disfiguring fairy ring. Control of the latter phenomenon will only come with better water management. Investment in the irrigation system is the solution.
- The fairways are probably the most improved part of the course since my last visit. Programmes of feeding, sanding, drill seeding, mat protection and wetting agent use have helped to strengthen swards and provide a better surface for golf. Consequently, the damage created by deer is less obvious. There is still progress to be made and this will come through refinement e.g. brushing and verticutting, alongside periodic lower cutting to aid blending and grass integration. There would be merit, in time, of reducing the height of cut to 15mm from 18mm, cutting more frequently and boxing clippings but these changes may require more manpower and or changes to the equipment fleet.
- The semi-roughs are well managed and offer appropriate width at a height of 65mm because they must act as buffer zones for balls running off fairways. The rough beyond this is unmanaged, very natural, but quite penal and intimidating to golfers.



- We note proposals to invest in the irrigation system and we can only support this as a sensible and sustainable source of spending. This will help day to day management standards and mean that water is used more efficiently with less waste in the future.
- Discussions were held about the development/improvement of the clubs practice facilities and the creation of a new short game area. It has proved challenging to recreate conditions found on the course in the environs of the clubhouse because soils are heavier and less well drained and the growing environment is more challenging (more trees), which compromises airflow and sunlight penetration to turf. Any work that is done in this area must involve the highest specification construction methods to create free drainage and the best possible growing environment.
- We are keen that performance measures are taken from greens on a weekly basis (7 greens at present) to provide a factual narrative about how the course is playing. Record moisture, firmness, green speed and roll quality using the smoothness and trueness scale with video support of the latter if possible.





Photographic Gallery and Comments

Photo 1. Most greens now provide a good cover of grass. Roll quality characteristics, firmness and speed are all judged to be good and are being measured by the club on a weekly basis. The botanical blend is strong with fescues being dominant in most cases. The strategy of encouraging fescues is the correct one because this grass type is deemed to be the most sustainable in this climate. We must work to refine and blend the other grasses into the fescue base using verticutting, brushing and grooming technologies to perfect the ball roll (bents and ryes can get clumpy and lateral in their growth habit at this time of year) but the fescue must be strong for this work to happen.





Photo 2. A close-up photograph of the sward on the 2nd green. Fescues are thriving through the base and density is now good, but coarser leaved plants (mainly bent and some meadow grass) are beginning to compromise the texture of the turf. Physical refinement is necessary to bring the blend together and improve ball roll further.





Photo 3. The situation is very different on the 1st and 18th greens both of which are significantly weaker. In both cases meadow grass (Poa annua) dominates and there is much less fescue. Disease scarring from the past winter is still obvious and the surfaces are pitted as a result. It was agreed that all greens need to be fed a little more to progress surface attainment more quickly each spring. However, the vulnerability of the turf at the 1st and 18th will remain each year because the growing environment (light and air) is poorer than it is on the rest of the course.





Photo 4. The surface of the 18th green is like the 1st with meadow grass the dominant turf type and disease scarring still impacting ball roll quality in early June. There is only a limited amount of fescue through the base of the turf so texturally it is inferior to most of the greens on higher and more open ground. Martin has tried seeding with other grass types here e.g. rough stalked meadow grass, creeping bent as well as the usual mixed fescues and browntop bents, but there is little evidence of success. With upper profiles in reasonably good order because of good aeration and top-dressing programmes, we must accept that environmental pressures and possibly poorer drainage to depth are conspiring to favour less desirable species. Reconstruction could be considered but unless the light and air dynamic is improved this process, which will be expensive, may not be as successful as we wish!





Photo 5. The profile from beneath the 1st green. Good quality top dressing has influenced the upper profile very positively but root growth is shallow confirming that the meadow grass sward is not fully utilising it. Note the weak and pitted turf in the background.

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Photo 6. Compare the previous photograph with this one from the 2^{nd} green where, physically the profile looks similar in the top 100mm but rooting is stronger. Note the more complete finer textured turf in the background.





Photo 7. Fairy rings are noticeable on some green approaches e.g. 11th ,15th ,16th etc. They are caused by basidiomycete fungi which are provoked and encouraged by wet and dry moisture cycles in the soil. Wetting agent applications can help and are being made, but the real solution is to have better irrigation control in these areas. The current system is deficient in this area.





Photo 8. The other challenge on immediate approaches and on some surrounds is contamination from crowns and stems of perennial ryegrass (Lolium perenne). This grass can interrupt smooth ball roll as well as the aesthetic presentation of the turf. The solution is similar to the bent in fescue concerns seen on the greens. The surrounding turf must be made stronger to allow physical refinement (here it needs to be a bit more aggressive) to ultimately provide a more uniform blend of turf. Focus attention on wear areas and machinery turning sections – it is here that the problem is at it's worst. It is a similar challenge to one we face on links courses in the UK!





Photo 9. The successful treatment of white clover (Trifolium repens) with iron sulphate is to be applauded. I can see big improvements on greens and green surrounds since my last visit and although clover is still present it is much less prevalent. It is having much less of an impact on playability and aesthetics. Given that pesticides cannot be used this is a real success story on this site. The photograph shows the surround to the left of the 16th hole which used to be badly contaminated with weeds only 4-5 years ago.





Photo 9. Clover is still present on tees as well but with careful treatment with iron and using masking sprays a good level of presentation can be maintained.





Photo 10. The fairways are perhaps the most improved area of the course since my last visit. Programmes of feeding, sanding, seeding, wetting agent delivery and mat protection have all combined to provide a more durable set of surfaces and platforms that are better able to accommodate physical pressures from golfers and from the deer. Maintaining a strong sward also helps to keep weed populations low. There is further progress to be made and I think adjustments to mowing programmes and refinement work similar to that talked about on greens and surrounds can be applied here too with benefit. The sand delivery is a big factor and is allowing the surfaces to be firmer in winter and cope better with worm casting.





Photo 11. The less intensively managed par three greens provide an insight into the potential pressures from weeds if the turf becomes weak. Note the plantain (Plantago sp) population in the photograph above. These need to be taken out by hand which is a very time-consuming operation!





Photo 12. We discussed the performance of the practice putting green adjacent to the range. This has never really provided a turf experience similar to the greens on the course. The sward has become heavily contaminated with meadow grass and is bumpy and uneven at this time. Fundamentally, it does not drain well during the wetter months of the year partly because of its location on wet ground. It serves to prove that if surfaces are being constructed at Copenhagen they should be located carefully and built using the highest specification materials and methods possible.

Course Recommendations

Greens

Sward Species Development

• The sward mix on greens largely reflects that of the wider environment. It comprises fescue as the dominant grass type on most greens with mixed bents (some coarse and lateral), rye (can be productive and uneven in growth habit), Yorkshire fog and meadow grass (often weak and thin). There is also some contamination with white clover, but this is less intrusive than it was on previous visits due to some success with the iron sulphate control measures (60 Kg/Ha application rates). The challenge is creating a blend that is visually acceptable and provides good ball roll for as long in the season as possible.



- The strategy of promoting fescue as the main sward component is fully supported. This grass provides natural pace and some natural resistance to disease in an environment where chemical disease control is not permitted. However, it must be maintained at a strength that allows subsequent refinement (verticutting, grooming and brushing) through the spring and summer months, which is very necessary to create the desired blend of species (see below).
- Fescue overseeding using narrow gauge pots (shallow 10-12mm holes) should continue each spring and autumn.
- Some green extensions are weaker e.g. 10th etc. Some layering to depth (imported with turf) was identified and might be impacting on fine grass health in these areas. There may be merit in carrying out some additional ninja tine work on these sections.
- Continue to keep white clover populations under pressure using iron sulphate sprays at 60Kg/Ha as required. It is important not to let this weed become dominant.
- Plantains should continue to be removed by hand. There is a job to do on several of the par three greens!
- Continue to overseed the 1st and 18th greens but I would concentrate on browntop bents as the best option. Dimple seed this into the surfaces regularly (3 or 4 times between June and September).

Nutritional Inputs and Refinement

- It was agreed that annual inputs of nitrogen should increase slightly to circa 70-75 Kg/Ha N per annum. An NK feed should be made all greens with immediate effect to start this process.
- In future seasons start the growth engine using two applications of lawn sand at 30 grams per square metre followed by a sulphate of ammonia-based feed in early mid April. This should provide a little more strength for subsequent refinement work.
- Refinement in the form of verticutting, grooming and brushing is required to turn surfaces that comprise 4 or 5 different grass types into a surface for play. The rye and coarser bent components, which can be problematic from both an aesthetic and physical perspective, need to be cut vertically as well as horizontally. I can't be too prescriptive about how often or how severely this work should be carried out but I urge the club to acquire and trial a variety of verticutting and grooming-brushing tools to find a combination that better provides the required outcome without damaging or thinning the fescue base too much. The message is to do more of this (frequency is probably more important than severity) but to do it without creating space in the fescue base. This will only lead to meadow grass and weed ingress, hence the need to feed to gain strength first of all.
- Success is about creating the right balance and a grass system which is growing sufficiently to recover itself, absorb vertical cutting and dressing applications.
- We support the use of hand machines to protect green edges. Avoid mowing below 4mm.
- A periodic reduction in mowing height to 3.5mm when bent growth is at its most active might assist the vertical mowing programmes to control lateral growth. Mowing heights should be raised back to 4mm immediately. This may need to be done 3 or 4 times during the growing season but never do it before active growth begins. Use your clipping yield measurement process to identify the best time to introduce this.
- Aesthetic presentation of the greens is important. More active feeding should help this aspect but where necessary use low inputs of iron sulphate, Attain and seaweed to mask weaker sections of meadow grass and greener patches of clover. Appearance can be positively influenced in this way and golfers will respond better to more uniform presentation. Turf pigments such as Syngenta's Ryder work in a similar way and may also help weaker greens such as 1st and 18th.



- We discussed the use of a tank mix to help suppress disease through the autumn and winter. Application applies to all greens but particularly the 1st and 18th which are more vulnerable to fusarium. The mix below could be used as an example. It should be applied at the first signs of disease and in response to forecasts of high disease pressure. This may mean, for instance, two applications in two weeks or one in six weeks depending upon conditions:
 - Look to utilise iron sulphate as the iron source as this will be the most acidifying option and therefore most discouraging to disease. Look to apply at a rate of circa 20kg/ha (which will deliver 4kg/ha Fe). Application at the early stages of disease can be very beneficial in aiding disease suppression.
 - Include magnesium sulphate within iron mixes on occasion to aid strengthening and surface acidification. This will provide more of a richer green colour to the turf when compared to iron alone. As an example, a mix of 10kg/ha iron sulphate and 10kg/ha magnesium sulphate could be considered. This would work well as a clover masking agent too.
 - Include potassium within each application this year to supplement soil reserves and ensure the plant has sufficient at its disposal for disease defence (see soil results in Appendix). Use either a proprietary liquid mix or straight sulphate of potash at a rate of 10 – 20kg/ha.
 - Include phosphite as a plant elicitor, selecting a suitable product containing no hidden nitrogen e.g. Asco-Phite (also contains seaweed), Fossil, Terrafirma Fighter, etc. Begin with the first application no later than early September, then continue monthly. It may be that this first application of phosphite is made within one of the routine seaweed or liquid N mixes to the greens if it is deemed too early for hardening mixes to begin.
 - If favourable weather windows occur through the autumn/winter where nitrogen input would be beneficial, then include small amounts of ammonium sulphate within the mix (2 – 3 kg/ha).

Organic Matter Reduction & Green Firming

- Clegg values taken during the visit revealed greens to lie in a range between 95 and 110 gravities. This is considered appropriate for week-to-week member play. The greens are thus firm without being too firm.
- Profiles are visually in good order and the aeration programme alongside the consistent top-dressing practices of recent years have led to the development of consistent, open, layer free profiles beneath all the greens. Even the poorer 1st and 18th greens show good upper profile amelioration and organic matter management. What they don't have is the higher-level drainage to depth that the majority of greens have.
- Organic matter values taken prior to this visit are ideal and largely in target. There are no major adjustments needed in this area of management.
- Aeration should continue to focus on use of the Air2G2 compressed air unit, the vertidrain once per season in the autumn and periodic narrow gauge procore/sarel roll work to keep upper profiles open.

Green Approaches & Surrounds

• A similar refinement approach is required on these areas to the greens. Here the challenge is more from coarser crowns of rye grass rather than bents and they sit proud more particularly in areas of wear and tear one walk offs and on approaches. A slightly stronger feeding programme allied to verticutting will help alongside ensuring that



mowing cylinders are cutting optimally to prevent fraying (this is much better than in 2018).

- Clover control is much improved so keep iron sulphate applications going here. The use of liquid spraying with seaweed, Attain and small amounts of ammonium sulphate will help appearance too.
- Density is better but keep this strong.
- Fairy ring activity on approaches is disfiguring (see Photo 7). These fungal induced rings are encouraged by fluctuations of moisture and the poor control of irrigation on these areas of the course make their appearance during the drier summer months more likely. Wetting agents are being used to help moisture management and this programme should continue. If rings become hydrophobic apply a curative wetter such as Aquatrols Aqueduct or equivalent to correct the problem.
- There is some discussion about investing in a newer and more efficient irrigation system. Although your water use is very light this would help reduce waste and would allow Martin and his team to better manage this problem. Without better coverage from the system, controlling these rings is down to hand watering which is very time consuming.

Tees

- Tees are generally tidy and presentation is better than it was four years ago with clover once again better contained. It is still there but is now at a level that is visually acceptable.
- Despite the above comments keep iron sulphate inputs going as required to keep the leaf small.
- Tees must be firm and flat so make sure divoting is regular, that top dressing is carried out at least twice per annum and that some level of verticutting is done to aid refinement too.

Fairways & First Cut Rough

- The fairways have improved more than any other area of the course over the last four years. The density of turf is much improved and there is much less evidence of turf weakness or deer damage. The lies that are offered are good for golf. All aspects of the programme including wetting agent protection, mat protection, more liberal feeding, overseeding with fescue and rye and sanding have all had an impact. The latter operation has probably had the most influence and sand can be seen through upper layers of the profile and is resulting in improved firmness and reduced surface worm activity in the autumn, winter and spring. Sanding should continue with the aim of applying at least 500 tonnes of sand per annum in two applications.
- The next step is to better blend the component grasses together. This comes from verticutting/scarification so the club should explore having its own facility to do this work on a regular basis. It should be supported by brushing to stand up grass before mowing.
- The current height of 18mm is generous but appropriate for a dry summer. If conditions remain clement (cool and showery) consider a reduction to 15mm and see how the fairways play. A periodic reduction to 12mm and then immediate raising again during periods of good growth may also help to refine swards more effectively.
- The longer-term goal should be to mow these fairways tighter (12mm) to accentuate the benefits of playing the game along the ground. However, this will have to be tempered with playability (we can't have balls careering into the rough from good tee shots) and weather.



• Aeration with the vertidrain should be targeted rather than generalised. Concentrate on wetter sections of turf and treat them before they get wet!

Practice Facilities

- We discussed the potential construction of a new short game area to the left of the driving range on the current par three course. There is no doubt that a green could be constructed here but it would need to be built to a high specification i.e. USGA guidelines in order to overcome deficiencies with soil type and drainage. This will add cost to the project. I understand the current specification only allows for 200mm rootzone, which, in my opinion is not enough. If the budget is fixed it may be possible to reduce the surface area of the green?
- We did question the location in terms of safety (from the driving range) but this is an issue for your architect to resolve.
- If a short game area was constructed here, would it be used? The club already has a short game area more conveniently located next to the clubhouse. Convenience is an important consideration when golfers are practicing. Satisfy yourselves that the location is appropriate and safe.
- The newer putting green adjacent to the range offers a poor surface and does not appear to drain well enough in the winter. Prolonged rootzone wetness together with the location of the green at the bottom of the hill are contributing to its weakness and its inability to mimic surfaces on the course. It better mimics the 1st and 18th greens which are found in a similar location. Future monies should be set aside for reconstruction of this surface.
- Plantain contamination of the par three greens is significant and requires a purge in the coming weeks. The only real way of dealing with this is removing the weeds by hand!

Soil Laboratory Testing Results

• Please see the Appendix of the report for soil laboratory testing results and analysis.

Staffing

• Current staffing levels (4 full time, 2 seasonals and 4 temps) are light for a facility of this calibre. Ideally, I would like to see a higher level of core full time staff (7 or 8) to allow for the additional refinement work and weed control work talked about in this report to be done at a higher frequency and with optimum precision.

Sustainability Initiatives

- This is one of the most natural of golfing sites in Europe. It sits in its environment very naturally and is a genuine extension of it. Its rustic charm is a key ingredient of its popularity as a golfing venue.
- The grass mixes that exist on all the playing surfaces reflect those found through the natural grassland on the site and are encouraged. They provide the most robust and sustainable solutions for the greens, tees, fairways and roughs.
- Because of the legislation in place the site is managed wholly without pesticides even down to the use of iron sulphate and physical removal mechanisms used to control weeds in turf.
- Controlled inputs of nitrogen and water are used to maintain low turf productivity.
- Coexistence with other human users of the site. The park is genuinely multifunctional and golf exists in harmony with this.



• Good standards of turf surface are maintained despite a head of circa 2000 red deer roaming the site.

Signed

Alistair Beggs Head of Sustainable Agronomy Services, The R&A



Appendix

Soil Laboratory Results & Analysis

Organic Matter Content									
	0-20 mm	20-40 mm	40-60 mm	60-80 mm					
	4.0 - 6.0%	2 - 4%	2 - 4%	2 - 4%					
Green 8	5.8	3.5	3.1	3.6					
Green 16	6.8	4.0	2.9	2.7					
Green 18	4.3	2.6	2.0	1.8					
Average	5.6	3.4	2.7	2.7					













Comments on Organic Matter:

- Overall, organic matter levels are good at all depths across all three indicator greens.
- In the critical top 20mm the 8th and 18th are in target and the 16th is above target. Surface levels of OM are slightly high at the 16th and need to be reduced. Given the nature of this raised level it should be straightforward to achieve this with adjustments to sanding and aeration programmes.
- At all other levels organic matter levels are under control and should (assuming other factors are consistent and optimal) create a good playing environment for year-round golf and healthy plant growth.

Soil Nutrient Analysis (Mehlich 3)									
	Soil pH	pil pH Phosphate F (P ₂ O ₅)		Potassium (K ₂ O) Magnesium (Mg)					
	5.0-8.0	> 10 mg∕l	> 35 mg∕l	> 50mg/l	> 150mg/l				
Green 8	6.5 (6.4)	33 (86)	20 (23)	80 (825)	1214 (1352)				
Green 16	6.4 (6.1)	31 (79)	20 (22)	85 (80)	1250 (1215)				
Green 18	6.8 (6.5)	42 (121)	14 (12)	75 (74)	1246 (1215)				
Average	6.7 (6.3)	35 (95)	18 (19)	80 (326)	1237 (1260)				

Comments on Chemical Analysis

• Two sets of chemical results have been produced on this occasion. The results in brackets have used the Mehlich 3 extractant. The comments below relate to the standard extractant we use in UK labs (non-bracketed figures) and our



recommendations are based on these results and our own thresholds developed over many years of soil testing on turf sites.

- Soil pH levels are mildly acidic varying between 6.4 and 6.8. They are considered ideal for promoting healthy sustainable grass types e.g. bent and fescue. Mehlich 3 values are similar if a little lower.
- Phosphorous levels are adequate and well above the threshold we use for supplementation. No additional phosphorous is needed at this time for healthy plant growth. Mehlich 3 levels are higher as this extractant is designed to enhance P values.
- Potassium levels are considered low in all three cases and below our threshold level of 35mg/litre. In this instance we would recommend that potassium is applied in an approximate 1:1 ratio with nitrogen for the remainder of the season. Interestingly, the MLSN outcome would advise similar guidance.
- Magnesium and Calcium levels are high enough in all indicator greens not to require supplementation currently. Mehlich 3 results are similar in most cases apart for Green 8 Magnesium, which is significantly higher.

R&A Sustainable Agronomy Site Information Questionairre			R&A'					
Activity			No	otes				
Total Nitrogen input to greens (Kg/Ha)		Lower than year before (70)						
Total Nitrogen input to tees and surrounds (Kg/Ha)								
Total Nitrogen input to fairways (Kg/Ha)		Building u	up vigor foi	r creating d	lenser turf			
Total Phosphorous input to greens (Kg/Ha)								
Total Phosphorous input to tees and surrounds (Kg/Ha)								
Total Phosphorous input to fairways (Kg/Ha)								
Total Potassiun input to greens (Kg/Ha)								
Total Potassium input to tees and surrounds (Kg/Ha)								
Total Potassium input to fairways (Kg/Ha)								
Total water use for course and greenkeeping operations (cubic metres)								
Number of fungicide applications made to greens (do not include spot treatments)								
Total number of applications of insecticide to greens								
Total number of applications of herbicide made to the course (do not include spot treatments)								
Sand dressing tonnage for greens (tonnes)								
Sand dressing tonnage for approaches and tees (tonnes)								
Sand dressing tonnage for fairways and other areas (tonnes)								
Any notable sustainability initiatives e.g. biodiversity creation etc.								

Annual Chemical, Fertiliser and Water Inputs

Comments on Annual Chemical, Fertiliser and Water Inputs:

- Annual nitrogen inputs are low at 48 Kg/Ha per annum. This is good in environmental terms and confirms that no more nitrogen than is necessary is being applied to the surfaces. The future aim is to maintain good plant health and an indigenous fine leaved sward blend without over application of this nutrient yet provide sufficient strength in the turf to allow refinement to take place. Increasing the annual input to around 70Kg/Ha N per annum was agreed with at least 50% of this applied by May of the year.
- Nitrogen inputs to tees, surrounds and fairways are higher to mitigate the effects of wear and tear and build up a stronger sward density on fairways to reduce weed ingress.
- Phosphorous inputs to all turf areas are low. This is recommended given that phosphorous is relatively immobile in soils and is not required in large amounts for the promotion of healthy fine leaved turf grasses.
- Potassium inputs are low too. Here, there may be merit in applying a little more K. This is confirmed with the soil results. It is required in approximately 1:1 ratio with nitrogen.



- Total water use is low at 3,300 cubic metres per annum. It is good to see such husbandry and efforts continue to optimise water usage on all areas of the course.
- No pesticide applications are made to the course at all. Alternatives have had to be found given prevailing legislation on this site and in the wider Danish market.
- Some 900 tonnes of sand is being used on the site per annum to help promote good firm year round playing conditions. This is appropriate and delivery of this has made a big difference to the performance of fairways in particular.