Dunfermline Golf Club

Course Report
March 2019

Paul Miller PhD

Report of Visit and Meeting of 19th March 2019

Dunfermline Golf Club

Summary and Recommendations

The golf course has benefitted from the dry year of 2018 and the relatively dry winter of 2018-19 and is remarkably dry, healthy and firm underfoot. The greens are showing typical end-of-winter condition with a little bit of yellowing on some e.g. 11th, a few disease scars (several greens) and some moss which is showing itself strongly (1st and 4th), however they are very much firmer than I have experienced before which bodes well for the season ahead. The greens are showing the benefit of the aeration and nutrition programme in particular of the last 3 years or so with organic matter under control and therefore greens holding far less water than was the case. Despite these improvements we need to maintain focus on the right aeration and nutrition programme and continue to incrementally improve the greens. For the season ahead I therefore recommend the following:

- Follow the nutrition programme provided by Aitkens, although don't become a slave to it as healthier plants use nutrients more efficiently and so there may be some potential to reduce the rate or frequency of applications. Let growth dictate the exact timings and quantities and be prepared to extend the interval depending upon that.

- Use the Air2G2 to target the zone at 100mm approx. to ensure the compaction there is relieved.

- Use wetting agents monthly during the season to allow water to distribute evenly through the soil.

- Control disease with fungicides if necessary as disease pressure and severity of outbreak dictate.

- Maintain winter height of cut until you are sure that spring has sprung, probably late April, and then lower slowly to 4mm minimum for the season.

- Once good growth is underway verti-cut as growth and weather allow to refine surfaces and improve ball roll without having too low a height of cut.

- Roll occasionally instead of cutting as growth and weather conditions dictate, particularly on the 4th green.

- On the 1st and 4th greens, once growth is strong enough, hollow core the mossy areas with small tines and apply a granular wetting agent and a product to improve CEC (recommendation to follow once I have heard from Aitkens).

- Irrigate through the season as weather dictates, and if it allows it, try to maintain soil moisture of around 25% in summer. This will contribute to firm and true surfaces.

- Consider hollow coring instead of using the Graden later in the season to further control the organic matter between 20 – 40mm.

Golf Course Report

Those present were Kenny Duncan, Jock McNeill, Joan Peden, and Paul Miller; we walked the course inspecting it in general terms and inspecting several greens specifically, and also took a look at how the work of recent months at the 4th and 14th greens has settled. We looked at soil profiles of several greens and took a soil sample from the 4th to send for analysis. This report will discuss these observations and attempt to explain some of the things that we are seeing on the golf course, and will make suggestions for on-going maintenance as we approach spring and the 2019 playing season.

General Condition

The golf course has recovered well from the strange weather year of 2018 and is coming through winter in good condition which will allow a solid foundation for the 2019 season. We have had a generally dry winter with very little snow, and the pattern of milder and then colder spells that is typical of winter in the east of Scotland, and thankfully we haven't sustained any prolonged period of snow such as we experienced in March 2018. My main observation is that, despite over 20mm of rain on the Saturday preceding my visit and 80 mm in the preceding week, the course was remarkably dry, which makes a positive difference. There has clearly been a lot of work on greens over the past 3 or 4 years and this is bringing benefits (to be discussed more fully in the next section) and there is lots of evidence of aeration work on the fairways, particularly on the landing areas and other vulnerable areas, and it feels as if water is moving through and off the golf course more readily than it has been doing in the past. Perhaps the sustained dry weather of 2018 has brought some changes to the natural soil structure of the site which is facilitating water; whatever the reason the improved dryness is certainly something that struck me. Dry conditions allow for improved turf quality in terms of density, texture and general plant health,

and also reduce the impact of worm casting which can be a perennial problem on parkland golf courses. Having said that there are one or two areas that remain a bit wetter but they are typically well-used routes for the greenkeepers as they get around the course to fulfil their duties. These areas are not in play and are restricted in size, and perhaps when spring is with us and these are dry enough to get on to they would benefit from some aeration and fertiliser just to pick them up and encourage grass cover. These isolated areas shouldn't be the focus of this report though, as in general terms the course is dry and in good condition.

Greens

Greens are the part of the golf course where at least 50% of the game is played, and so are the focus of the golfers' and greenkeepers' attention, and are a significant factor in determining the impression given of a golf course to both members and visitors alike. I first visited Dunfermline Golf Club and prepared a Golf Course Report in May 2017, and learned then that Kenny Duncan and his team had a strategy and plan to bring about long-term and sustainable improvements to surfaces by addressing issues within the soil profiles and the nutrition of the turf. I shall come on to these topics, but will first consider the surfaces.

Greens Surfaces

The greens at Dunfermline Golf Club have a full coverage of grass that appears to be in good general health as we approach the end of winter. The sward composition remains a combination of bentgrass (*Agrostis*) and annual meadow grass (*Poa annua*) and generally has good colour and density and is fine in texture. This is pleasing as it is at this time of year that turf generally shows in its least good condition given the rigours of winter and that spring growth hasn't yet commended in earnest. One factor determining this is soil temperature which varies as the weather varies but sits between the daily maximum and minimum air temperature each day; as such these are at present around 5 or 6°C which is a temperature at which grass will start to respond. Fertiliser had been applied to greens the day before my

visit and so some footprinting was evident but this will quickly fade as the fertiliser takes effect, which will be within a few days if temperatures remain as they are.

I have used the term 'generally' above to describe the greens and of course there are one or two areas of exception. There is some fungal disease scarring on several greens whilst others have areas of moss, and the 17th has some Yorkshire Fog (*Holcus lanatus*) within the sward (this grass shows as areas of silvery-green grass and is coarser in texture than the more desirable species). Let's deal with each of these in turn.

Fungal Disease

The fungal disease present is Fusarium Patch, a common disease of fine turf and more prevalent in moist areas. Fungal diseases of turf (and indeed of other species) can be described by a model known as the 'disease triangle', in other words there are three factors that come into play for a disease to occur. Firstly we need a 'host', in our case a grass species – *Poa annua* and *Agrostis* are both susceptible to Fusarium, whilst other grasses are unaffected by it. Secondly we need a 'pathogen', or disease-causing organism; in this case a fungus which has the Latin name *Michrodochium nivale*, and thirdly we need a conducive environment. The environment has an impact on the general health and therefore susceptibility to disease of the host plant through factors including wet and airless soils, poor nutrition, and stresses brought about through e.g. low heights of cut or other aggressive management, and it also affects the pathogen (the fungus) which is active under conditions of shade, mild and humid nights, areas of poor air movement, and dew formation on the leaves of the grass. So when we have species that can get the disease living in damp and airless environment, which also favours the activity of the pathogen, then disease outbreaks are likely to occur. Conditions as described are not at all uncommon in parkland golf courses which are on heavy soils and often have shade and poor air movement due to trees, and the combination of all of these factors is known as 'disease pressure'.

Management of disease therefore presents several options – a good understanding of what is going on allows a combination of preventative measures including the control of thatch, improvement of drainage, reduction of shade, a good fertiliser programme, and low-stress management practices. All of these reduce disease pressure, and whilst they don't eliminate it completely it means that outbreaks are likely to be less frequent, less damaging, and easier to recover from. Disease management also requires a decision about if and when to apply a fungicide; if one is required there is the choice of a 'preventative' that can be made when disease pressure is high and disease is anticipated (perhaps there is an 'indicator green' that shows signs earlier than the others) and 'curative' which is applied once the fungus is active and symptoms are present. (Full advice on chemical use must be obtained from a BASIS qualified representative). This can involve deciding on thresholds as to the tolerable level of disease scarring in each and every golf club, and the likely speed of recovery if disease does develop, and of course there is a financial implication.

So, having said all of that, I am not surprised or disappointed to see a little bit of disease at Dunfermline. Parkland golf usually has a high disease pressure, so to see some Fusarium patch is not at all unexpected at this time of year, and it might sound perverse but to see some disease means that Kenny hasn't automatically reached for an expensive chemical at the first sign of disease, but is using his experience to monitor and make decisions about the disease given the time of year, the fact that fertiliser has just gone on, the fact that weather is windy at the moment so air is not sitting still allowing humidity to build up, and that nights are still relatively cold. I am confident that Kenny and the team will continue to monitor the disease and manage it effectively, and I expect that as spring growth comes the turf will recover from the current level of scarring fairly quickly.

Moss

Moss is an interesting phenomenon. My view on moss is that we should think of it as a symptom of something that isn't quite in balance within the soil / turf environment, rather than as a specific issue in itself, that we therefore consider the various factors that mean it is

prevalent in some areas but not in others, and take actions to address the causes as well as the symptoms.

Moss is an indicator in fine turf that the grass with which it coexists in a green or other area is not competitive. The reasons for this can include poor soil conditions relating to nutrition and water-holding capacity, and somewhat counter-intuitively moss can win the competition for space, light and other resources in fine turf in very dry and nutrient-poor soils. We conventionally think of moss as a plant of wet, shaded and acidic locations, and whilst this is true it is not exclusively found in these conditions. Because moss doesn't have true roots it has evolved a variety of strategies to retain water within its own structure that it can use during dry spells, or to go into an inert, dormant state during periods of drought. My experience in fine turf is of two main types of moss, the first of which is a surface-growing moss which comes and goes with the seasons, and retreats into dormancy as the year warms up and as the grass reasserts itself in spring. This moss can be readily brushed or scarified out of the sward and is rarely troublesome in the growing season. A second moss type is a cushion moss which is a much darker green, and which can be prevalent all year round, particularly in areas where the grass is struggling. This moss has a different structure and can be between 5 and 10mm thick, meaning it is far more difficult to remove by scarifying. This is the type that is troublesome for us at Dunfermline.

Interestingly at Dunfermline the two greens most affected by the moss are the 1st and 4th. Each of these has been constructed (at different times) using a much higher sand content than the other greens on the golf course. Sands are great for allowing rapid movement of water, but are poor at supplying nutrients and at retaining water, so turf in sandy soils can experience stress through not having these basic needs met, and so becomes less competitive than we would like. It is my suggestion that this is what has happened on the 1st and 4th and so we need to find a way to provide better nutrition and water to the grasses in these two greens in particular, and any other where moss is significant.

A conventional approach to moss is to use Sulphate of Iron to blacken the moss and check its growth, and then to scarify the moss out of the sward when it is weakened. If the timing of this is right it allows the grass to then reassert itself into those previously mossy areas. Kenny has a plan to repeat this treatment on the 1st and 4th, and whilst I am not against this I feel that we need to also try something additional in these greens to bring about longer-term changes i.e. to help the grass become more competitive against the moss. I also have a concern that overuse of Iron for this purpose will over-acidify the soil and begin to create a toxic condition known as 'Black Layer', and indeed there appears to be the beginnings of this in the profile on the 4th green. As I have set out in earlier reports the strategy I have recommended is to improve the overall health of the greens through the aeration and fertiliser programmes, and I'd like to continue this theme into these greens in particular, and recommend the consistent use of wetting agents to try and create a uniform soil environment for these greens, and then a supplementary nutrition programme for the 4th in particular, dependant upon the results of the soil test (we took a soil sample from the 4th and I will prepare a supplementary report once I have the results back for that). I shall detail these recommendations later.

Yorkshire Fog

The green on which we saw the most Yorkshire Fog was the 17th. This green used to be one of the wetter ones and because Yorkshire Fog is most at home in wetter soils the explanation for it being there is straightforward. This green is now much drier and healthier and so the balance will tip against Yorkshire Fog, however in the meantime some localised brushing of that grass before cutting, and the use of verti-cutting as growth allows during the season, will stress that grass and reduce its impact. Another thing that could be tried is to put the hole nearer to those patches of Yorkshire Fog in order to increase the wear around it, as it isn't very wear tolerant and will be stressed by foot traffic. This will compromise ball roll around those areas so isn't a good idea for competition days, but if it could be done perhaps for a day a week during regular play it wouldn't do any harm.

Greens Soil Profiles

It was two years ago that I first came to Dunfermline Golf Club to prepare a course report; at that time Kenny and the team had started a programme of aggressive organic matter reduction, and had changed the fertiliser approach to introduce 'softer' fertilisers with the view to reducing big swings in growth and to contribute to soil health. During my first visit we looked extensively at soil profiles and I recommended to continue with the organic matter removal and control, and to address some deeper layers of compaction within the profiles. In my view great improvements have been made in this area and we are seeing the benefits in drier and firmer surfaces that are better from the playing point of view and better agronomically.

In golf greens there is a strong correlation between organic matter content and moisture content of greens, especially in the top 20mm or so of the profile. Moisture content in turn affects the sward composition (grasses which will grow in those conditions) and the health of the grasses that are present, it increases disease pressure, and it creates soft conditions from which it is difficult to create firm, smooth surfaces meaning that if green speed is a significant objective then there is a real temptation to reduce cutting height, which in turn stresses the grass plant further. It is fair to say therefore that organic matter content is a significant determinant of the ease of management of fine turf and the performance that can be expected of it. Organic matter levels can be measured in a laboratory and for the most prestigious championship venues on the sandiest soil a target organic matter content would be between 4 and 6% by weight; for a members' parkland course in central Scotland this would be ambitious but it would be great to get it below about 8%.

Organic matter has been measured in a laboratory for the 1st, 8th, 11th and18thgreens at Dunfermline Golf Club and the results are shown in Figure 1.

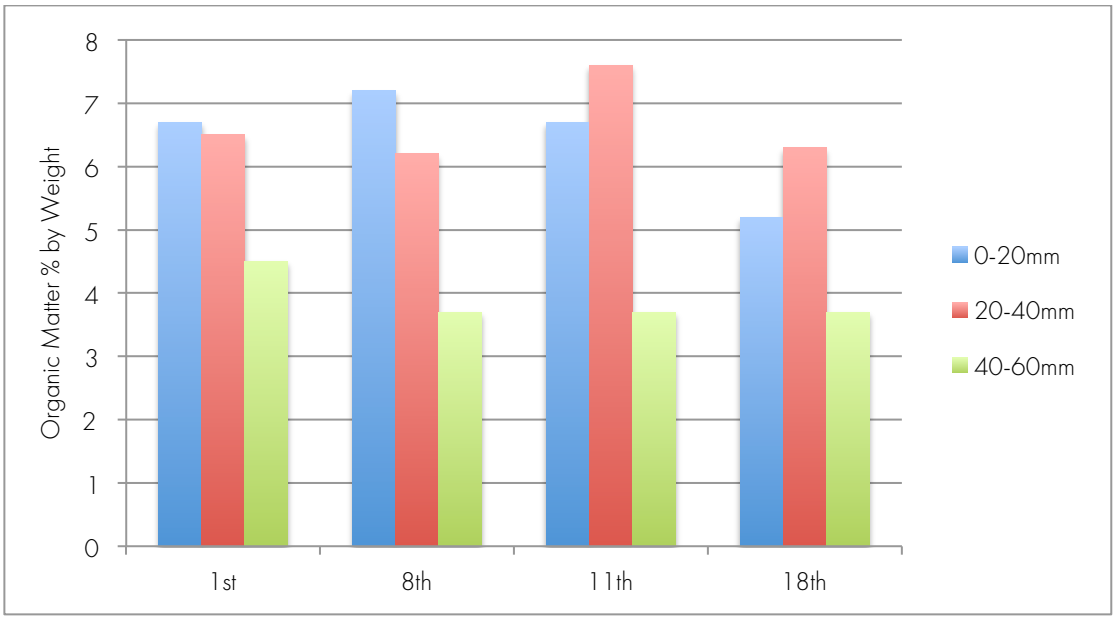

Figure 1. Organic matter levels at three depths in greens 1, 8, 11 and 14

The organic matter in the greens at Dunfermline ranges from 5.2 to 7.2% in the top 20mm, from 6.2 – 7.7% between 20 and 40mm, and from 3.7 – 4.5% at 40 – 60mm. These are good numbers for golf greens on a course such as Pitfirrane, and are a result of Kenny's work with the Graden, and of the aeration programme that has been allowing water to percolate more freely through the profile. These levels of organic matter are approaching target range, but the job is never complete because all the while the grass is growing it is producing organic matter and this needs to be dealt with somehow, and all the while there are golfers and greenkeeping traffic causing compaction to the soil the conditions for organic matter build-up are being created. An area of slight concern is the higher organic matter between 20 - 40mm than in the top 20mm in two of the greens – it is as if the Graden has dealt with the top 20mm very effectively but the layer beneath isn't being reached with that method. I'd recommend some further hollow-coring to continue to work on this area.

In addition to the high organic matter in the surfaces we previously identified a compact layer at some 100 – 150mm and then the native soil beneath that was also quite dense. Kenny and the team have been working hard with the Air2G2 to relieve the compaction in these areas and from the profiles we looked at during this visit there are great improvements in this area, further evidence for which is provide by the ease with which the soil sampling tool can

be pushed into these greens. Despite real improvements there is some residual compaction at the 100 – 150mm depth and the plan is to use the Air2G2 this spring to bring further improvement to that area.

In summary therefore in talking about soil profiles, it is clear that great improvements have been made to these in all three areas that were of concern two years ago, and it feels as though we will be transitioning from an 'improvement' phase into a 'maintenance' phase over the next year or so. The reduction in organic matter reduces water held at the surface, and more friable soil beneath allows it to percolate through the green, leading to drier, firmer, smoother, and healthier surfaces. I think that after so much good work it would be careless to take our eye of the ball in terms of soil profiles, so we need to maintain regular monitoring and planning of maintenance such that we are able to continue to improve these greens incrementally and maintain them at an optimum level for Dunfermline Golf Club.

New Drainage Works

When I visited in October 2018 the new drainage works at the 4th and 14th were underway, and on this visit I find them to be complete. Kenny is very positive about the difference this work has made to the wetness of the 4th and 14th greens, which gives us a foundation to further improve the condition of them. Despite the great improvements to the condition of the 14th here was a little residual wetness and softness on the left side, however with the spring aeration to come it is anticipated that this will be reduced.

Related to all of the foregoing we found the 11th green to be the weakest of those that we inspected. The colour and general plant health, although improved from previously, is poorer than the other greens. We talked again about the potential for installing a catch drain above that green to intercept the water which we believe to be shedding off the slope above the green towards the 5th as it makes its way to the ditch in the wooded area to the left of the 11th green. I am pleased that this is under discussion and feel that maintenance can only take this green so far without an investment in a drain in this area. Not being a

drainage expert I would defer to someone with greater experience as to the details of how this would be achieved practically.

Greens - Summary and Recommendations

There have been real improvements to the greens at Dunfermline Golf Club over the past two years. A committed programme or aeration targeting three areas of concern in the soil profiles has led to drier and firmer surfaces and healthier turf, which will allow the presentation of improved surfaces during the playing season. Despite these improvements there are some areas of further concern that need to be addressed; disease pressure remains as is typical of a parkland golf course at this time of year, and Kenny is managing this using his knowledge and experience; moss is of concern in particularly on the 1st and 4th greens and can be attributable to the different construction and the high percentage of sand used for that; there are a few areas of Yorkshire Fog on some greens, most noticeably the 17th.
My recommendations therefore are as follows:

Aeration

Continue to work on the organic matter levels and try to get below the 20mm level to address the material between 20 and 40mm depth. This can be achieved through timely hollow coring which could be an alternative this year to using the Graden.
Use the Air2G2 as planned to target some compaction at about 100mm.
Continue with routine spiking and slitting as weather and ground conditions allow.

Nutrition

Follow the nutrition plan created by Gavin Speedie of Aitkens and continue to use 'soft' products that cause less instability in the soil and encourage soil organisms. A caveat to this is not to be slavish and to make decisions based on observations of plant health, growth rate

and weather conditions. My expectation is that the healthier turf that is now apparent will use fertiliser more efficiently and so a modest reduction in fertiliser use is possible whilst achieving the same results. It would be a pity after creating drier and firmer surfaces to then over-produce lush growth which then softens and slows the surfaces. As such I'd be mindful of not over-applying during the playing season.

Disease Control

There is no doubt that there will be periods of high disease pressure as spring progresses. We have an improved picture of drier and healthier turf but Kenny needs to remain alert to the possibility of disease outbreak and be prepared to spray if disease pressure is high and if symptoms are becoming apparent. The use of dew dispersants during periods of high disease pressure, and maintaining good levels of nutrition, will also help to minimise the impact of fungal disease, but of course there are always times when a spray is required.

Moss

In addition to any use of iron and scarifying I'd recommend working hard to improve the competitiveness of the grass in the mossy greens. The cushion moss that is present might not reduce a great deal under iron and scarifying, and so I'd like to recommend a programme whereby the mossiest areas are cored and top-dressed with a material or materials which will retain water and improve nutrition e.g. a granular wetting agent, seaweed or similar organic amendment, and a material that can improve nutrient retention. There are several products on the market that claim to improve these aspects of a soil, for example the Terralift fertiliser products, and also a product from Sherriff Amenity called 'Stor-It'. I am happy to speak with Gavin Speedie and / or others on your behalf to try to identify the right product. This is subject to the outcome of the soil test for the 4th.

Kenny and I discussed the use of wetting agents and I'd recommend the continuation of these on all greens, with the objective of improving soil conditions throughout. For the 1st and

4th the use of a granular wetting agent after aeration (coring) would improve water retention and turf competitiveness in these greens.

Surface Preparation

Slowly lower height of cut as the weather and turf conditions allow – we often suffer cold easterly winds in April that can stress the grass, so exercise caution and don't reduce heights too quickly. I'd recommend no lower than 4mm in the season which, with the improved dryness and firmness of greens, will allow smooth and true ball roll.

Brush and / or verti-cut as growth and turf health allow, with the objective of improving smoothness of the surfaces by controlling lateral growth.

Irrigation and Water Management

We talked about soil moisture levels – if these can be held at 30 – 35% by the soil management that has been undertaken over the past 2 or 3 years this gives great potential to create firm and true greens. Using the Pogo to monitor moisture levels I'd recommend allowing these to get to 20 – 25% in summer and holding them within that range if possible, assuming we don't have a summer that constantly keeps 'topping up' the soil through rainfall. In any case, even if they are consistently at 30 – 35% during a wet summer this is very encouraging.

Other Areas

I have already briefly commented on fairways which we found to be dry and firm, and on this occasion we didn't specifically inspect any tees. My only comments are as I have said before – tees need light, nutrition and aeration if they are to perform well throughout the season – and I am confident that Kenny and the team will manage these effectively as the season comes in and levels of golf pick up.

Paul Miller PhD

March 2019