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There must be ...

Sixways to use your cover!

Worcester Warriors Head Groundsman, Martin Knight, has struggled to keep the pitch playable in the face of a troublesome drainage system coupled with torrential rain - a recipe for disaster you might think, but not so, as we discovered

SPECIAL FEATURE

ON THE WING AT TWICKERS

We meet Binki the Harris hawk, who is charged with keeping the pigeons at bay at Twickenham Stadium

AGRONOMIC INVESTIGATION

It has been three years since the infamous '2mm debate' was held at Harrogate in 2010. Now, the instigator, Greg Evans, returns with the 'facts', collated over three years of trials

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The 2mm debate

Agronomic Investigation

It has been three years since the infamous '2mm debate' was held at Harrogate in 2010. At that time, there were many angry greenkeepers out there shouting "he can't sustain it" and "they will be dead in three years!" Well, three years have passed and "they" look okay to me!

The problem was that there was no scientific data to back up my shortcut method. I knew that it worked (from a player's perspective), but was unable to point to a reliable source that explained why. However, there was also no evidence to say that it couldn't work.

We'd all heard stories of greenkeepers who had lost their greens because they had been cutting them too short. Lots of stories, but no facts!

As the debate began I started some agronomic tests. By compiling the results, I hoped to produce a body of data that would go some way to proving my method. From the start I looked at what a 2mm method could achieve from an agronomic point of view. I felt that a short cutting regime in a parkland environment could reduce organic matter levels and help in the prevention of disease attack. The other thing that intrigued me was the bad press that Poa annua has had over the years, contrary to my positive experiences of it. To investigate the results of cutting at 2mm and Poa's performance, I looked at:

- Organic Matter levels
- Soil and Tissue nutrient analysis
- CEC and pH values
- Percolation rates
- Compaction levels
- Bulk density
- Sward density

Ealing Golf Club's Greens Profile

Before I go in to these areas in depth, I feel it is important to give you a true reflection of the profile of Ealing's greens. Ealing was built in 1898 and sits in a river basin, with a sub-base of London clay. The greens' profile consists of a 60mm USGA sand profile, sitting on top of 200mm sandy/loam and then, wham, clay!

The greens are roughly 8000m² in total and drainage on the greens is pretty non-existent, as old clay pipes form the land drainage. Some of these can be located one metre deep but, instead of pea shingle covering them, we have hard core!

Right from the start, when I was appointed Course Manager in 2006, I decided to by-pass the clay pipes and work on the rootzone percolation instead. Deep verti-draining, with heavy sand dressings, formed the backbone of my programme. It creates what I call 'sand channels' within the sandy/loam profile, allowing water to move from the surface and enter the sub-soil. To date, this method has worked well. Prior to my appointment, temporary greens due to wetness were common at Ealing.

The Data Programme

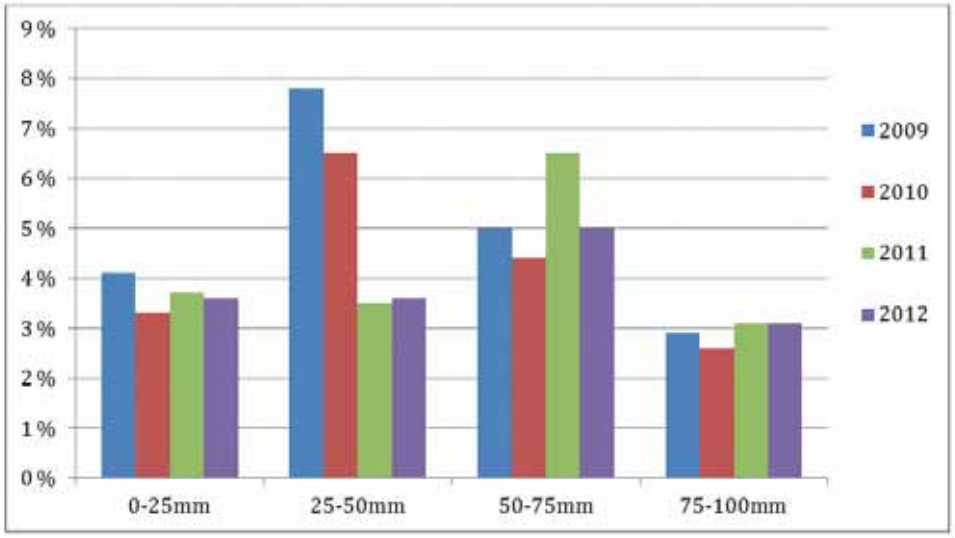
All of my data has been taken from our second green. It is 450m² and in a fairly open position. The back drains pretty well, but the front of the green can get quite wet. The grass species is 99% Poa annua and 1% Browntop Bent (I'm doing my best to get rid of that 1%).

Organic Matter

Although the data programme is three years old, I have organic matter (OM) data stretching back four years. I will include it here as I consider control of OM in turf maintenance to be a priority for a successful greens performance.

This is the industry accepted 'Loss on Ignition' test, externally conducted by


Sand Channels in the top soil



Organic Matter Percentages - Target 5% and below

European Turfgrass Laboratories based in Stirling. The results are shown above.

As shown by the graph, over the years the OM levels in the greens have been controlled with the greatest improvement in the 25 to 50mm layer. Although I have no doubt that the sand and aeration programme has played a part, I think that the tight height of cut has helped too. In 2006, the grass plant that I inherited was a fat, beefed up Poa Annua cut at 5mm. The tighter I cut, the finer the species seemed to become. I regret that I didn't conduct OM tests back then, as I am sure the figures would have been a lot higher.


The greens I inherited

Soil and tissue tests, plus pH and CEC values

This is an area that has always intrigued me. As a raw, naive course manager at my previous course, fertiliser company reps came in and performed soil tests. They told me that the soil was deficient in various things and out of balance. According to the reps, I urgently needed to correct this. However, the greens looked fine to my eyes; nice and healthy and certainly not near death as the sales rep was suggesting.

When compiling the nutrient analysis data, instead of concentrating solely on soil analysis (which is the norm), tissue samples are also collated. This gives me a better overall view of what is actually going on inside the plant.

I annually conduct these tests independent of fertiliser companies. The results tell me a lot:

Soil Testing	Guideline Figure	2010	2011	2012
Phosphorus	26ppm	13	12	12
Potassium	241ppm	72	126	132
Calcium	1600ppm	1018	1104	1107
Magnesium	50ppm	63	82	119
Sulphur	10ppm	17	48	47
Zinc	4ppm	5	4	4
Copper	4ppm	3	2	2
Iron	50ppm	923	1275	890
Managanese	45ppm	17	15	15
Boron	0.5ppm	1	1	1
Sodium	90ppm	31	71	86
CEC	15meq	7	7.7	8.1
PH	6	6.3	6.2	6.4
Bulk Density	1.50g/cc	1.81	1.78	1.54
Test externally conducted by ETL				

As you can see, a lot of these elements seemed a long way from the guideline figures. Look at phosphorus, potassium, manganese and calcium. They are way under their guideline figures, whereas elements such as iron and sulphur are way over. Intriguingly, these guidelines seem to come from the agricultural market - so, are the guidelines relevant to our crop, turf grass?

As soon as I started performing these tissue tests rather than soil tests, this whole area started to make sense. All of a sudden elements such as P, K and Ca were not under, and Fe and S were okay too. If you looked at the soil test figure for Manganese, it came in at around 15ppm, way under the accepted level. One fertiliser company tried to get me on a Manganese programme at a cost of over £1k per year. But, as soon as the tissue tests results came in, I could see that what was actually in the plant was okay, and I didn't have to spend lots of money to correct the element levels.

Percolation rates

Water control, along with OM levels, is another important factor in producing firm, good greens. You need the soil to retain moisture when it's hot and release it when it's pouring down. This is the basis of the USGA golf green design.

On old courses, such as ours at Ealing, it is very hard to achieve. Over time, the percolation rates of the greens naturally slow down as OM levels build up. The drainage system in our greens was pretty antiquated, and installing a new system was outside the club's budget. The only option that I could see was the 'deep aeration and sand' approach which would, at least, get the rootzone functioning again. But, how did I know that this method was working? I could see

Tissue Testing	Guideline Range	2010	2011	2012
Nitrogen	4-5%	4.43	4.69	5
Phosphorus	0.4-0.6%	0.46	0.48	0.5
Poassium	2-3%	2.78	3.09	2.96
Calcium	0.4-0.6%	0.36	0.39	0.41
Magnesium	0.2-0.3%	0.19	0.2	0.21
Sulphur	0.2-0.4%	0.48	0.51	0.53
Zinc	45-65ppm	56	60	63
Copper	10-20ppm	16	14	16
Iron	200-400ppm	406	353	374
Managanese	100-150ppm	101	109	113
Boron	10-15ppm	6	7	7
Sodium	0.01-0.04%	0.01	0.01	0.01
Test externally conducted by Robert Laycock using Near Infrared (NIR) Spectroscopy method				

Note: Samples are taken monthly and the figures shown are annual averages


Infiltrometer working on the 2nd green


Tools used during the three year tests

that the top surface was firming up, and that waterlogged greens were a thing of the past, but I wanted data.

The Infiltrometer uses the double ring system. It has a ball resting on the top and a gauge that measures the downward movement of water in mm/hr. I test the percolation rates every month in three positions on the green. Before I begin, I saturate the rootzone for at least ten minutes to make sure I get a 'true' saturated reading. These are the average annual results:

- 2010 - 31mm/hr
- 2011 - 28mm/hr
- 2012 - 39mm/hr

As you can see, there was a slight dip last year, but improvement was vast this year, even with the greens being pretty much saturated due to heavy rainfall. It will be interesting to see whether the trend continues.

Compaction

I test compaction levels using a penetrometer. It measures pounds per square inch at different layers in the soil. The idea is to see if any pans have built up over time which affect water movement throughout the profile. Monthly, I take nine readings across the green (see graph below).

As soon as the test was implemented, I could see that there was a slight pan between the 100 and 200mm layer. Over the years, the aeration of the greens was channeled in this range as that was what the machinery capabilities allowed for. Based on the results, from 2010 we started to aerate above 100mm (shallow aeration) and below the 200mm layer (deep aeration). Now, when I put the penetrometer into the greens, I feel it sliding through the 100-200mm range, instead of feeling resistance.

Sward Density

My last agronomic test measures sward density by recording the number of leaves in a randomly selected 2cm². As with the other in-house tests, it is conducted monthly and the average results for each year are as follows:

- 2010 - 104 plants in a 2cm²
- 2011 - 116 plants in a 2cm²
- 2012 - 102 plants in a 2cm²

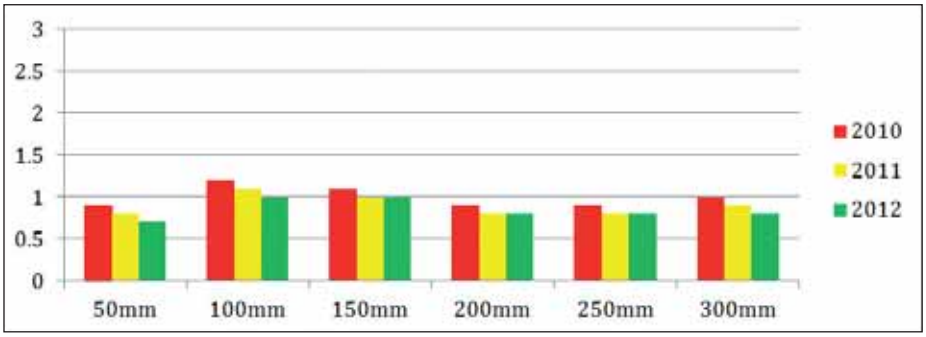

Measuring sward density

The density of the sward appears fairly consistent over the years, with a slight increase in 2011. I observed that, if I took a reading after a granular application of fertiliser, the numbers would shoot up but, after a foliar application, the numbers were very consistent. It proves, once again, that to produce consistent growth, little and often applications of fertiliser are needed instead of giving it all at once.

Maintenance Programme

In the past, I have been criticised for not giving the full picture. So, in the spirit of full disclosure, and before I go on to my observations and conclusions, here is the full greens maintenance programme at Ealing Golf Club:

Ealing GC Greens Maintenance Programme			
Item	2010	2011	2012
Nitrogen kg/ha	150	149	152
Phosphorus kg/ha	23	22	31
Potassium kg/ha	261	226	166
Sand Tonnage	186	154	125
Aeration	13	7	8
Verti-cutting	10	7	2
Fungicide Applications	4	4	4
Overseeding	0	0	0
Rainfall (mm)	483	477	743
Irrigation (mm)	216	183	110
Evapo-Transporation (mm)	614	639	580
Speed in Feet - Apr to Sept	10.6	10.8	10.2
Speed in Feet - Oct to Mar	8.2	8.3	8.4
Smoothness 1 to 10 - Apr to Sept	N/A	8.9	8.9
Smoothness 1 to 10 - Oct to Mar	N/A	7.6	8.1
Height of Cut (Prism in mm) - Apr to Sept	1.9	2	2
Height of Cut (Prism in mm) - Oct to Mar	2.6	2.9	2.7
Rounds played	30,962	35,392	33,997
Greens cost in £ (including all wages set at £10.5ph, materials and fuels)	27,780	26,570	25,798



Compaction Test - PSI

Conclusions

Collating this data over the last three years has taught me a lot about my own greenkeeping methods. A lot of questions were raised by the 2mm debate, but I had no way to prove my results. My method was based largely on 'gut feeling'. The method obviously works, and is successful, but I made many mistakes and could have saved time and money if the data had been readily available. With three years hindsight, I conclude the following:

- To produce top greens performance (playability and agronomy) the feeding programme has to be right. By analysing plant tissue, as well as testing the soil, I can fine tune greens growth. I stopped panicking about what was going on inside the plant. If you look at my soil results, you can see many nutrients were way out of their guideline figure. However, once I started collating tissue samples, I could see that they were plentiful inside the plant and expensive fertiliser to add nutrients wasn't required.
- Poa annua was always thought to be a high thatch producer, giving slow, bumpy greens. I don't find it so. If your fertiliser programme is based around granular fertiliser (which used to be the norm), then a fat, beefed up grass plant will be produced. On the other hand, if you give it little shots of nitrogen and apply sand dressings, a much slimmer version is produced which provides very little thatch and smooth, fast surfaces.
- Using accurate organic matter information, I targeted aeration and sanding where it was needed. One of the biggest concerns with heavy sanding is that you can bury the OM in the profile, but using tools such as the penetrometer and having OM samples tested at certain depths, you can gauge where your troublesome spots are and act accordingly.
- My OM figures have come down over the years. There is no doubt that the sand and aeration programme has helped but, in my opinion, the tight cutting height has played its part too. Think logically. Less leaf mass = less mass to break down.
- When I became CM at Ealing in 2006, I overseeded a lot with colonial bent. This was to help support the Poa (which was weak) and create a dense sward. However, just before the data programme started, I totally stopped overseeding as I felt that the Poa was strong and would support itself. Plus, the seed cost a bloody fortune! The big concern is that, when you stop overseeding, sward density can suffer. That is why I include a density test in my programme. The sward stays dense as long as the Poa is healthy. Again, making sure your feeding programme is spot on is key to the success of this.
- Our fungicide bill has come down from a high of £10k (viewed from past records) in 2004 to £2.4k for each of the last three years. Firming the surfaces up with good cultural practices, such as sand and aeration, has helped, but a tighter cutting height than previous regimes also created a drier top surface.
- People often comment that my method costs too much to implement so, along with the agronomy data, I track the greens cost, everything including wages (around 60%), fertiliser, sand, fuel, etc. My greens cost came down from £27,780 in 2010, to £25,789 last year, a reduction of around £2k (without allowing for inflation at around 2.5% each year). This cost accounts for 9% of the course budget and 2% of the club's annual turnover. The reduction is entirely down to savings made by using the data results.

Personally, I am glad that I decided to implement this data programme. I find that it has taken the guesswork out of greenkeeping and, ultimately, allowed Ealing's greens to improve further. It perhaps goes a small way to proving that a 2mm cutting height works. I hope that anyone considering this type of regime finds my information useful and that, in the future, more of us can share our findings for the benefit of the industry.

If you have questions on this article you can contact Greg by email: *gregevansmg@gmail.com*, by phone: 07951 157208 or via his website: *www.gregevansmg.com*

For the complete story, you may wish to read previous articles. These can be found on our website by searching the author's name.