The latest FEGGA conference was held in Fuengirola, Spain, and took 'Water Management on the Golf Course' as its main theme. BIGGA's Executive Director, Neil Thomas reports...

Flowing conversation

FEGGA's second conference was held in Fuengirola, Spain in November.

Delegates attended representing their Associations from Austria, Belgium, Denmark, Estonia, Finland, France, Germany, Great Britain, Iceland, Ireland, Italy, Norway, Spain, Sweden and Switzerland.

The conference was again sponsored by Toro as part of their commitment to the education and training of greenkeepers throughout Europe and on this occasion they were partnered by Supaturf/ Aquatrols given the theme of the conference "Water Management on the Golf Course".

The conference also featured a FEGGA summit giving delegates the opportunity to express their views on the future development of FEGGA and to review its progress since its inception in March 1996.

Below: Mark Gunter of TORO lectures on irrigation systems

The first part of the programme dealt with the theory and reality of water management while the second covered strategies for effective management. Justin Smith of Supaturf began with a review of soil-water-plant system basics and the implications for responsible water management. He was followed by Mark Gunter of Toro who reviewed the basics of irrigation systems. Demie Moore of Aquatrols then gave an excellent introduction to water dynamics, repellency and movement in the soil-water-plant system. The first part of the programme concluded with Justin Smith giving an interesting talk on water management in turf.

The second part of the programme began with Justin Smith covering practical applications of moisture sensing before Mark Gunter dealt with the key principles of irrigation systems. Demie Moore then spoke on rootzone delivery and managing water movement.

Mike Meyrick, currently working in Switzerland, followed with a paper on water storage and legalities before David Stubbs concluded proceedings speaking on issues relating to water within the "Committed To Green" document.

Delegates benefited from an in-depth study of water management and some really excellent presentations before relaxing at the Toro dinner which was highlighted by the presence of flamenco dancers with three delegates being invited to take to the dance floor. It is better that they remain nameless!

The next day saw the first session of the FEGGA summit followed by a visit to San Roque Golf Club and a tour of the golf course under the guidance of the Head Greenkeeper, Salvador Gonzalez, President of the Spanish Greenkeepers Association.

The final morning saw the second summit session before delegates departed throughout Europe albeit reluctantly given that Spain was still enjoying hot, summer weather.

FEGGA's AGM will be held in the Majestic Hotel, Harrogate at 12.00 pm on Thursday 21 January where a large attendance is anticipated of members of associations affiliated to FEGGA as well as other interested parties.

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Ad Ref 9

There are those who think that the management of golf turf requires no scientific understanding or input at all. Conversely, do not get hung up with science, apply it, use it, question it and you will quickly realise that the wonderful world of golf course management encompasses the best of both worlds - science and practice. David Rhodes, Senior Lecturer in Sportsturf Agronomy, at Merrist Wood College beams us up into the 21st Century...

The appliance of Science

The dictionaries tell us that science means fact or knowledge, understanding. I think this places the importance of science within golf course management today. I will define my philosophies on the application of science and try to show how it can be directly applied to modern turf culture. How it can be used as another tool to assist in creating a good golfing experience through good golf course turf.

The Endaphic Environment

As our limited understanding of endaphology expands, we are becoming more and more responsive to turf grass rootzone needs. I believe that good soil can help in producing good turf and the study of this important area can really assist in your work.

Examples of this type of work currently being undertaken include research looking at the effects of Vessicular Arbuscular Mycorhizal fungi in turf grass roots and the symbiotic links with turf grasses. Endaphology is defined as the science that deals with the influence of soil and other media on the growth of plants.

The practical application of findings and fact is equally a challenge that we must embrace. We will move towards proving things and justifying to ourselves and others that operations and tasks undertaken actually work. Those managing golf facilities in the public sector will feel the implications of the search for quality under the umbrella of best value.

Of course there are benefits in adopting this approach. Who wants to undertake tasks that are achieving nothing or even worse are detrimental to our golf turf? A good example of this is so called aeration.

Science has taught us that amongst other things plants and microbes in our soils require oxygen for aerobic respiration. In order to achieve optimum gas exchange (the exchange of 02 and CO2 between the atmosphere and soil) we must produce a soil that has a distribution of varying pore spaces. The difficulties in achieving this in the field are wide ranging, therefore we tend to employ methods of cultivating our rooting mediums to encourage this. I believe that one should ask several questions in relation to what we are trying to achieve.

Do we fully understand our objectives, and the factors that may influence our achievement of these?

Can we discount the rules of science applicable in this case because it doesn t suit us?

How do we know we are employing the best methods to aerate our site?

How can we measure this both scientifically and practically?

Let me offer further explanation. Unless we define what we are trying to achieve, we make the assumption that we are achieving something positive (oxygen content of the atmosphere is 21% so one might argue that soil oxygen levels should be comparable). Realistically between 10–20% is achieveable.

Of course other factors can affect actual achievements in relation to rootzone oxygen concentrations for example:

- Soil texture
- Structure
- Type of ground cover including species
- Rainfall / precipitation
- Topography
- Contouring
- Moisture content of soil

The appliance of Science

Above: Applying science to the management of golf turf

Top right: Merrist Wood, an ideal seat of learning

Increases in plant and microbe respiration require additional inputs of oxygen (an example being seedling respiration). This can vary depending on the time of year.

Unfortunately the calender of science was not designed around the Golf Club competition calender so lateral thinking is called for. Alternatives are both available and feasible.

Should we assume that machinery available to us actually aerates the soil? No, it depends - what options does one have?

Where, when, how? Ask questions.

Germination and PLS

The fairly diverse number of grass species found on today's golf courses perhaps indicates that species selection for use can offer more options than is traditional.

The sentence above does not detract from fine fescues and bents but I believe that plant breeders have now made available alternatives to cope with the demands of the modern game - after all it is fair to assume that the so called traditional species may not be suitable in all instances , equally so new species may not be either.

One thing we do know however is that a seed requires water to germinate. Simply put, a seed imbibes water through the testa or coat due to internal salt concentrates, Gibberellin is produced which stimulates the alurone layer to produce an enzyme called analyse which in turn breaks down the reserves of starch to sugars and fuels initial germination until the plant can look after itself.

If you understand the full spectrum of a plant's requirements then it can throw into question seed mixes, seed rates, seeding techniques etc, (hence the reason drill seeding has become popular). Species to watch include:

Definite
- Perennial rye grass Lolium perenne
- A and G series bents

Possible
- Poa annua reptans
- Poa supina

Pure live seed calculations are simple to undertake and can assist with cost effective selection of seed species and cultivars. Any reputable seed supplier will supply data sheets for a given cultivar which amongst other things gives valuable information on purity and germination (viability). Before use by any purchaser the seed is produced to meet % purity and % germination figures as laid down by law. The percentages are usually higher than required by law because of a voluntary standard that seed companies work to. The laboratory tests show actual seed species (including weeds) and debris , for example 1% Poa annua seed by weight equals 250g x 3000 seeds per gramme which equals three quarters of a million potential plants in a 25kg bag. The viability of the seed, (number germinating in a petra dish) can be related to the condition, age and care of the seed.

All in all it gives the user valuable information when selecting and costing seed. The calculation is simple:

Purity x viability	=	99% x 99%
÷ 100	=	98.01%
90.25% of 25kg	=	24.502 g

This means that nearly 0.5 kg of the bag is weed or waste and if we divide by the cost of a bag it gives us a cost per kg for comparison between suppliers.

When the seed has been purchased, post seeding mortality and factors in the field will also contribute to overall loss and species success.

Quality measurement can and should take place in golf course management. When benchmarks have been established, operations should show a continuation or improvement in standard, workable routine tests that are easily carried out or requested include:

Species Quality and Composition
- Turf speed
- Grass frequency and density

Soil Quality
- OM Content
- Nutrient content & availability
- pH
- Porosity

Overall one can build a picture of where the course and particularly the turf lies in relation to perceived quality and current thinking on golf course agronomy. This provides additional support and justification to your decisions. Remember assume nothing.

I hope you have enjoyed reading the article and it stimulates you into finding more out about science.

Here's to good turf!

Water - Water
Why can you skim stones on a pond? Why can you fill a glass with water just above the rim? The answer lies in the chemistry of water. H2O is a wonderful molecule that reacts and changes all the time. The forces of adhesion and cohesion should be studied in detail to understand a lot more about water management and its use on golf course turf. It will help you understand the perched water table or suspended water table construction more as well.

Dormancy
True dormancy is defined as the suspension of physical and physiological processes that occur within the plant and this rarely occurs on cool season turfgrass. I believe it is more appropriate to use the term resting when we would normally use the word dormant as this explains what cool season plant actually do. True dormancy turns turf brown in colour and affords maintenance opportunities in its own right. There is a greater likelihood of true dormancy occurring in this country in summer not winter. Remember the right word choice implies greater understanding and more knowledge of the subject.

Etiolation
Solve this one if you can! This has been noted widely in golf turf management with several explanations offered for this unusual symptom. At particular times of the year, autumn being a common season, a chlorotic (lacking chlorophyll) singular leaf emerges rapidly from fine bents and poa annua. This disfigures the turf and is difficult to remedy.

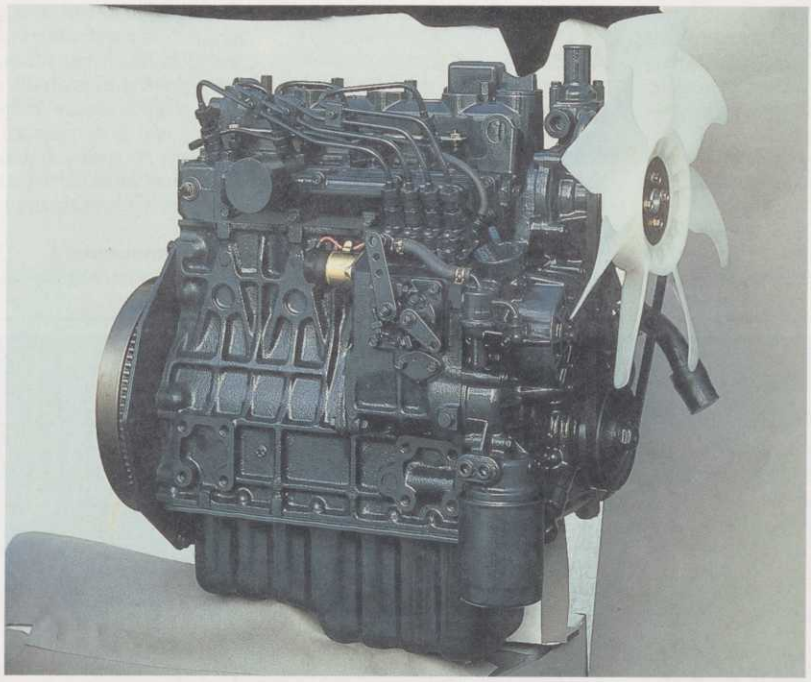
Reasons suggested include:
- Of fungal origin - mildews
- Nematodes
- Stress
- Shade

We know that the production of this mutant singular leaf is caused by a release of ethylene (a growth hormone) and its extended functioning is reliant on other parts of the plant for water and nutrients etc. Frictional contact between the new shoot and rootzones seems to stimulate this ethylene production and this may be one reason why verticutting or grooming the turf may actually stimulate adverse reactions and short term results are not achieved. Any advance on this?

Allelopathy
Why does Yorkshire fog tend to form patches in established turf? There have been many explanations offered over the years to answer this question. We all know that the plant can stand close mowing regimes and grooming / slashing operations as well. I offer this most interesting answer - its allelopathic.
The production of toxins by plants is not a new phenomenon, but little is understood about it in grasses particularly amenity grasses. Recent research has shown that Yorkshire fog along with fescue and perennial ryegrass produces toxins typically phenols, cumarins, tannins etc to control the dominance of other species (interspecific competition). The result of this is more apparent in Yorkshire fog than the other species but nevertheless offers a scientific reason why the species seems to patch itself on fine turf. It is also one of the few grasses that flowers twice a day.

Roland Taylor looks the harmful gasses produced by the internal combustion engine and examines ways of ensuring damage to the ozone layer is minimised.

Smog warning



As we stand on the 18th green with a clear blue sky overhead, the sun shining down and a light breeze blowing down the fairway, it is hard to believe that all this fresh air is a myth and lurking out of sight is something sinister.

No, this is not the beginning of a thriller it is fact not fiction, air pollution throughout the world has become a major problem and one of the biggest culprits is the internal combustion engine. Four by-products result from the fuel burning process carbon monoxide, Hydrocarbon nitric oxide and particulates - all potentially harmful.

Carbon monoxide (CO)

High concentrations of this can affect the blood and nervous system and are generally considered to be the biggest threat to health. This pollutant is produced as a result of incomplete fuel combustion due to a lack of oxygen. The critical factor in its production is the fuel and air ratio (carburettor setting on a petrol engine, injector on a diesel). A rich mixture produces CO, while a lean one keeps levels down.

Hydrocarbons (HC)

Hydrocarbons react with nitric oxides in sunlight to form ozone, which can cause respiratory problems.

These are also formed due to incomplete combustion, but there is a difference in the case of a very lean mixture. Ignition is likely to become unstable or the engine misfires, then emission levels of hydrocarbon rise.

Another source of this pollutant that is often overlooked is fuel evaporation from spillage or containers.

Tests carried out in America showed that among all non-road combustion engines, small power units, especially two-strokes, contributed to about 4% of hydrocarbons from all sources. The emission tests were as follows: 67% from exhausts; 23% due to evaporation and 10% from spillage.

Nitric Oxide (NOx)

This gas is produced when nitrogen and oxygen are combined at high temperatures and its formation is once again dependent on the fuel and air ratio going into the combustion chamber. Lowering the engine temperature by retarding ignition timing and re-circulating exhaust gases does reduce NOx formation, but this tends to reduce power output.

Particulates (Black smoke)

Tiny particles of burnt or unburnt carbon are discharged from engine exhausts. These are thought to increase the risk of heart or lung problems. Diesels produce more of this than their petrol counterparts.

Carbon Dioxide (CO_2)

Even when fuel is burnt efficiently carbon dioxide is discharged. While this does not harm health it has been found to be a contributor to the greenhouse effect.

Smog warning

As far as pollutants are concerned there is little to choose between emissions from a diesel or petrol four-stroke engine. In the case of a two-stroke power unit the picture is different and indications are that even with all the latest technology they will not get through the next round of CARB regulations in America, hence the introduction over recent years of smaller four-stroke models.

Over the last decade the research departments of engine manufacturers have been working flat out to come up with design improvements that will enable them to comply with the California Air Resources Board (CARB) emission regulations. These came into effect in January 1995 and not only laid down engine performance levels, they also required manufacturers to establish facilities for measuring emissions from every unit supplied into the Californian market. Their introduction has become a benchmark for all engine production throughout the world.

Engines now coming onto the market have improved fuel economy, produce less noise, work at low temperatures and are said to have greater reliability and durability.

Most readers will have several engines in their fleet, so what measures can be taken to reduce pollution?

Engine maintenance

This needs to be carried out as laid down by the manufacturer. Not only will it help to reduce the emissions, it will ensure the engine continues to produce its optimum performance.

Cooling systems

Regardless of which system the engine has, the most important factor is keeping the airflow moving over the cooling areas. Build-ups of dried grass or dirt between the cooling fins around the compression chamber or in a radiator can dramatically reduce the system's efficiency. The temperature within the engine will increase resulting in a drop in performance and subsequently higher levels of pollutants.

Air filters

As we have seen, the volume pollutant gas produced is dependent on the correct ratios of air to fuel. Dirty and clogged up filters restricts air intake and change the mixture getting into the combustion chamber. Ignition is less effective and a high level of neat fuel is discharged into the atmosphere via the exhaust.

This also occurs if the carburettor setting is incorrect. Apart from the pollution aspect, more fuel is wasted and the engine's performance is only mediocre, thus placing more stress on both machine and operator.

Ignition

The correct spark or fuel injection at the right time is critical. A dirty or wrongly set plug in the case of a petrol engine, or faulty injector on a diesel, will upset the balance.

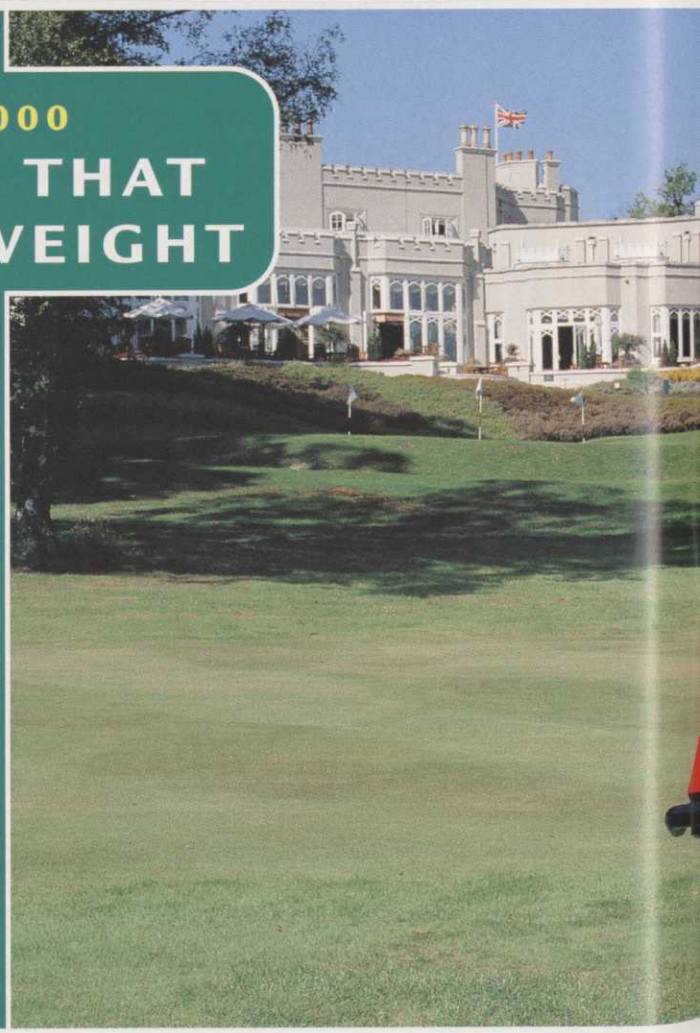
Spark plugs should be the correct type for the engine and have an adequate heat range.

Lubrication

Oil reduces friction and dissipates heat. If in short supply hot spots develop and unless oil levels are topped up immediately a costly bill will be incurred. Top quality lubricants should always be used. For two-stroke mixtures there are available smokeless based oils. These only produce carbon dioxide and water vapour from the combustion process and no carbon residues are deposited in the engine, so internally it is kept cleaner.

Fuel management

Modern petrol has a shelf life and the



Previous page and far left: Eco-friendly engines from Briggs & Stratton come with a variety of Horsepower options

Immediate left: A Kubota engine undergoes regular maintenance as an integral part of Environmental concern on the Golf Course

formula is likely to be changed about three times a year. This is to reduce the vaporisation rate during hot spells and increase it when the temperature drops. Because petrol has a limited life, any machinery not being used for long periods should have all the fuel drained off, or a fuel stabiliser can be added to the tank.

When experiencing starting problems, it is worth first checking the fuel is not stale, especially if the equipment has been laid up for some time

Fuel should be stored in a cool place and needs to be kept in an approved and labelled container, which is fitted with an airtight cap.

Clean up any spillage as quickly as possible to stop hydrocarbons being released into the atmosphere.

General

Drives, transmission and cutting systems need to be maintained and set up correctly so that minimal stress is placed on the power unit. It is important it is to ensure the engine is running correctly and the rest of the machine's components are not causing overloading.

Manufacturers, instruction books will give details of servicing and adjustment routines.

Repower an attractive option

There comes a time when an engine's performance is well below par.

At this stage it is likely to be spewing out plenty of gas emissions becoming difficult to start; more likely to break down and running costs are escalating.

A decision has to be made whether to invest in a complete new machine. As most course managers and greenkeepers are faced with financial constants, this may not be a very practical solution. There is another possibility that is worth exploring - re-powering. This has some distinct advantages and the cost compared to a new machine will be very attractive.

The new engine incorporates all the latest technology. Features like reduction in fuel consumption can represent considerable savings over a period of time. Lower noise and emission levels contribute to the environmental issue and the engine carries a warranty. It may be an advantage to change from a petrol engine to a diesel unit.

Providing all the other components of a piece of equipment are okay, repowering is an option worth investigating. Your local engine supplier will be able to advise on suitable replacements and can carry out the work.

The future on a global basis indicates that legislation in some countries is becoming increasingly stringent and engine manufacturers design teams are being pushed to the limits of technology to comply. Other forms of fuel are being tested such as natural gas. At present this is mainly on applications where a stationary engine is used, mobile applications are on the drawing board.

Electric power has already been introduced on golf machinery. Everyone is out to seek acceptable solutions, but it is also up to those responsible for using engines to ensure they are maintained to a standard that minimises unwanted gas emissions.

Pollution is a growing problem that has to be addressed it will not go away.

Next time you are out on the course and take one of those deep breaths just ponder for a few seconds on how much poison the engines under your care are discharging into the atmosphere.

Howard Swan, President of the British and International Golf Course Architects (BIGCA), extols the virtues of teamwork when it comes to producing the successful golf course.

EQUAL partners

When the R&A, in 1987 published its market research document 'The Demand for Golf' we all thought the good times had come! Just the 700 more golf courses by the end of the '90s, increasing our national stock by a third. And so it came to pass that we saw a rush of blood to the head of many, a climbing on the bandwagon, a clamour to make a quick buck. Developers arrived, with or without adequate cash or funding, banks were prepared to back them. Business plans were presented, most of them highly optimistic.

People believed them. The EU Agricultural policy, thought set aside, encouraged farmers to give up their knovn business and turn to recreation. Golf seemed a good bet, especially to those who played it at their local club.

The boom came...

No overall strategy...

No overall direction...

Where would golf courses be?

The 5th green at Royal Wimbledon and its restored bunkering is a fine example of a successful partnership between architect and greenkeeper, resulting in outstanding work.

What type of course should they be?... Surely not the ubiquitous championship course! Yes, why not, it sounded good! Was there really the demand in the locality? Where would the players come from? Was it sufficient to suggest that one 18-hole course needed a population around it of 20,000?

It seemed to be... Golf courses sprang up all over the place. The planners were inundated with applications for permission to develop golf courses. They could hardly cope. Permissions were granted on the flimsiest of information.

Those in the golf industry rubbed their hands together. Architects, contractors, irrigation experts came out of the woodwork. It would be fair to say some cowboys appeared, and reappeared to take advantage of and from the boom. To meet the supply, new recruits to the greenkeeping profession were needed in biggish numbers. Three or four years intensive activity on all fronts.

Inevitably standards fell.....

Design, construction were not alone. Financial integrity seemed missing on many occasions. Too many times were projects architect led, without adequate client briefs. Too many who designed courses were not professional architects. The results soon showed!

Too many times did too much money get spent. Budgets were exceeded, if there were budgets in the first place. Financial disasters loomed. With too high an expectation of returns, and too high gearing levels, there was little chance to service capital let alone interest.

Too many times did greenkeepers have to pick up the remains.

The economy turned, recession arrived, with many golfing bankruptcies. There is much truth in the idiom that the third owner gets the best deal! So, some ten years later have we found this out.

However, hopefully we've learned much from the roller coaster ride of the late eighties and early '90s, and the market is now better for it. We are all the more discerning from the experience, and we are all the more appreciative of the need to work together as a cohesive team.

We are all the better that there are now considerably less new courses being built and the concentration of many is on the existing stock, old and relatively new, and how these can be improved, renovated, restored to meet modern day demands and expectations.

However there remain new courses to be designed and built if the Henley Futures report is to be believed – another 300 or so.

If that is to happen it is vitally important that these courses are designed correctly, properly, professionally by suitably educated and experienced golf course architects, no matter where they might be, or to what scale they might be required. Putting architectural work in the hands of those unqualified is a recipe, almost without exception, for disaster.

The record of the past ten years supports such a view. Designs need to be properly planned and documented after sites have been thoroughly investigated, technically as well as commercially. Working drawings need to be prepared golf courses are no longer designed on the back of a cigarette packet! - and specifications and Bills of Quantities or schedules of work made up to define simply and clearly the quality and extent of work envisaged in the project. This can then be priced, on a competitive basis by experienced and reliable contractors who are committed to make an honest attempt at adhering to such specifications. Not all, sadly, have done, or do. From this, a developer can have a good grasp of his cost outlays, and his funding programme.

Every new course needs growing in. Establishment is not a task to be