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3. Enter your login details and select the BIGGA Training & Development Manual from the left hand menu.
4. The Training Manual will load and the user can click on Enter the Site to view a welcome video or can select 1–9 or 10–18 on the top menu bar.
5. You can progress through the manual hole by hole or go straight to the hole you wish to view. You can also skip to holes 10–18.
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# MAPPED OUT

*Archie Stewart highlights just what a GPS system can add to a Course Manager's arsenal*

**GPS is a technology that is mature and proving to be an invaluable part of our infrastructure. It is used for navigation; guiding planes in to airports via flight paths and ships along sea lanes to ports around the world. For scientific research it has made accurate measuring of the polar ice caps and melting glaciers possible. It can track anything from trucks carrying valuable cargoes to elephants in Africa. It is used in agricultural to drive giant tractors and machines through dust and darkness. With experienced labour very scarce growers of high value crops can achieve a constant level of accuracy for the application of fertiliser and pesticides ensuring maximum output and reducing operator error. It is a vital tool for business improvement in many sectors and can increase efficiency and save costs.**

## So how is GPS being utilised in golf course management?

The most common application of the Global Positioning System (GPS) in golf management is in course surveys. The initial GPS survey and mapping may be best carried out by contractors who can provide high accuracy and are well versed in the use of GIS (Geographic Information System) mapping software. It is worth the extra investment to provide a useful geographic appraisal of the prime asset of the golf club, the course itself. The survey provides a snapshot in time of the course which is easily updated and kept relevant. This is a valuable record of historic and current management practices, landscape and other features and forms a base for course management and development planning.

Accurate area measurement for all features of the course, like tees, fairways, bunkers and greens are the minimum requirement of a survey. This information is invaluable for precise calibration of spreaders and sprayers. The certainty that you are working with current measurements for each feature should allow for accurate ordering of inputs and robust record keeping. The survey will be produced as a digital map that can be linked to a database to allow records to be kept regarding each feature on the map. The survey should also show buildings, areas of different habitats, feature trees, ponds and wetlands.

Golf courses don't sit in isolation, so combining aerial photos and Ordnance Survey maps add value by showing the immediate surrounding environment that may influence many factors on the course. This context also produces an attractive and accurate map for scorecards and websites, and even for the wall of the clubhouse.

Maps are an excellent media that can be used as living documents and updated over time. Maps can be printed for daily tasks and planning to help communication with staff, committees, golfers and the public. They can show development plans, plans for new planting or new bunkers. They can also be used on signboards to inform the public about paths, location of dog bins and the plants and animals that live on the golf course.

GPS comes into its own when installing irrigation, or any underground services. Anyone who has tried to dig a burst drain or find broken control box from a set of old drawings of the irrigation or drainage system will know that what the plan shows and the location of the pipe or control box may not be one and the same. The use of GPS to record the position of the pipes or drains as they are laid ensures that they can be found again in the future. The location can be shown on the course map or if there is no course map they can still be recorded and added later.

## Once the survey is done and installed on computer, what next?

After obtaining your professional basemap, you can begin to update this

yourself. Buying and learning to use a compact handheld GPS receiver to take onto the course to record information and locate features is the next step. There are a range of receivers available from small units used by walkers with an accuracy of four or five metres to units that can download the course map and have accuracy of about one metre. As with most things it is a case of getting what you pay for, more expensive units will be more accurate and prove better value for money in the long term. The units should be rugged enough to withstand daily use in all weathers, recording and transferring data should be simple otherwise they will not be used to their full potential.

With the map installed in a handheld GPS unit it is possible to go on course to record areas of weeds or disease, wet patches and soil sample points or any other feature that is needed. All the information gathered can be transferred to the office computer and laid over the course map to record treatments and results. Areas of weeds or diseases can be shown as maps and these maps can be used to reduce the amount of pesticide used by treating only the area required instead of a blanket application. This has obvious savings in terms of cash as well as the environmental benefits.

The location of soil sample points can be shown and the analysis can be displayed in a nutrient map allowing investigation into any problem patches with the ability to record the results in map form and on a database. Any applications can be tailored to try and resolve the problem and the results monitored. GPS brings the ability to manage areas large or small record and display the results in a form that is easily understandable.

If drainage is a problem and, as is often the case, plans for the existing drainage system are old and possibly inaccurate areas that flood or lie wet can be recorded and plans made to remedy the problem. At the other extreme during times of drought the lines of drains sometimes can be clearly seen and that is a good chance to record their position.

Maps can be created that show how habitat management is working, gorse areas responding to rotational cutting, location of bird life on the course in fact almost any feature on the course can be recorded as required.

Many buggies are sporting GPS screens and scorecards to help the golfers with their round. These can also bring revenue to the club in the form of advertising of local services and with a relay back to the clubhouse be used to monitor the location of each buggy and the pace of play.

The decision by the PGA to allow the use of GPS rangefinders in professional events this year will inevitably provide a sales boost for the products and an opportunity for clubs to benefit from having an accurate course map. The range finders can only be as accurate as the information (course map) they contain.

By looking to agriculture we may take a guess at what may be available for golf and amenity work in the near future. GPS guided tractors are becoming common for the application of fertiliser, sprays and ensuring that high horsepower tractors with wide equipment is working at optimum rates with no overlapping or missed bits. Mowers could be equipped with GPS steering control that would ensure that each bout was made at the full width of the mower ensuring an even cutting pattern allowing the operator to concentrate on the machine and saving time and fuel. Details of the shape, width and height of cut can all be stored in a database building up a record over the years.

Application of sprays and fertiliser could be targeted to the areas predefined by soil, weed or disease maps. With increasing regulation these maps would show justification and control for treatment of pesticides.

GPS is a relatively new tool in the course manager's armoury that is yet to be fully integrated and realise the potential it offers. Investment in a course map perhaps to be followed by handheld GPS data receiver can be gradual process to suit the budget and ensure that the club is making the most of developing technology to take it into the future.

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# THE EVOLUTION OF SOIL WETTING

*By Demie Moore, S. Kostka, L. Lennert, M. Franklin, P.Bially, R. Moore*

FEATURE

**Wetting agents, also known as, soil surfactants or wetters, are getting increased exposure. With efficient water use and conservation being goals for both environmental stewardship and sustainability, the effect of wetting agents on water delivery to soils and overall water needs is being considered beyond Dry Patch management. A look at the evolution of these turf management tools may lend some perspective and the opportunity to understand some good, "bad", and practical news about these widely used, yet still vaguely understood, materials.**

## In A Nut Shell

Invented in the mid-1950's soil wetting agents/soil surfactants have gone from a single, purpose formulated product and some detergents to well over 50 products developed specifically for turf management. There are significant differences in the chemical structures and performance of many of today's soil surfactants; and there are a variety of effective products to choose from which will be more or less effective in different situations.

The good news is that there are more legitimate soil wetting agents/soil surfactants on the market than ever before. The "bad" news is that no single test can tell you which product is "the best" for you. Turf managers are best served by reviewing their particular needs and the objective information on available products, followed by evaluation and choice of what best suits their situation.

## The Originals

To better understand the variety of products available – a review of their "evolution" may be useful. AquaGro (Aquatrols), the original patented soil wetting agent, was a blend of nonionic surfactants including an alkylphenol ethoxylate (APE) and a fatty acid polyglycol. Between the mid-1950's and early-1970's few other effective and safe products were available.

In the 1960's Dr John Letey, at UCLA-Riverside, tested two products on very hydrophobic soils. These materials were Aqua-Gro (a mid molecular weight surfactant blend) and Soil Penetrant (a low molecular weight surfactant). The two products performed very differently. Aqua-Gro wet more slowly and was highly adsorbed on the soil particles. Soil Penetrant wet faster and deeper and was not readily adsorbed on the soil particles. Differences in plant safety were also recorded with Soil Penetrant being more phytotoxic than Aqua-Gro on the plant material tested.

Other research in the 1960's was conducted by Drs J. Boodley and R. Sheldrake, at Cornell University, looking at surfactants for better wetting of peat-based horticultural substrates. They found that, even within the non-ionic group of surfactants which were by then considered to be safest for use with plants, there were differences in wetting efficacy and plant safety.

The first controlled research specifically for use in turf management was conducted in the early 1970s by Drs J. Beard and P. Rieke, at Michigan State University. They evaluated the effect of several products on water repellency and dry patch on golf courses. Of the 10 or so products tested, only AquaGro and HydroWet were effective in combating dry patch. Both products contained an APE as an ingredient.

While APEs were not the only surfactant ingredient used in soil wetting agents, they and a particular one - nonylphenol ethoxylate (NPE) - were the most widely used ingredients in the effective products available through the end of the 1980s.

At sufficiently high rates, NPEs are effective for wetting water repellent materials. Because these compounds adsorb tightly onto soils, they also provide some residual effectiveness. NPE effectiveness, and how long they last, depends greatly on the rate of active ingredient applied per area and the soil environmental conditions. Unfortunately, rates giving acceptable results were also quite phytotoxic if not sufficiently diluted or aggressively water in immediately following application. At today's conventional water spray volumes – NPE based materials are likely to burn most turf. To address this, some products have been packaged in diluted formulations, recommended at very low rates, or require application of large quantities of water with or directly after application. While this is effective for lowering toxicity – it also reduces efficacy.

## Early Innovations

In addition to APE based materials available to turf managers, other surfactant ingredients were also packaged for use on turf in the late 1970's and 1980's. One example is the anionic surfactant sodium lauryl sulfate found in shampoos. Other mixtures of APEs, anionics and nonionics also appeared. The amounts of active ingredient and water in different products varied dramatically. Many of these wetting agents, at fairly low rates, will increase water penetration into soils to some extent. However, by their chemical nature, most do not adsorb onto soil and therefore have little to no residual effect.

Other innovations in the early formulations included – injectable (granular formulations), "Pellets" for hose end application, and "Natural Products" such as the Yucca and seaweed extract materials. While the "natural products" are indeed less phytotoxic to turf, they show limited efficacy at improving wetting. An NPE is often added to the formulation to enhance performance. Most of these innovations continue today in certain product formulations.

## A Step Beyond in the 90s

In addition to phytotoxicity concerns, in the early 1990s APEs also became suspect from an environmental safety standpoint. The concerns were potential for long-term accumulation in waterways and endocrine disrupting behaviour from some breakdown products. While adsorption and degradation in soils would likely mitigate these problems, some companies chose to look for more environmentally benign alternatives that were safer to turf and still effective as soil wetting agents. This combination of performance parameters was found in "block copolymer" surfactants.

The first block copolymer based product brought to market was HydroFlo followed soon by a differently structured block copolymer, Primer 604 Many other block copolymer based products followed. This ushered in an age of products that were effective against water repellency and could be applied in lower amounts of water with no need for immediate watering in to avoid turf injury. Most of the products introduced in the 1990s were block copolymers of one sort or another – whether injectable products, treatment or monthly program products, or "season long" products. The particular block copolymer chemistries vary, as do the suggested application rates, both contributing to differences in performance between products. This is similar to products in the pesticide field – where, although the broad class is the same, the performance of particular formulations varies.

Also making an appearance in the 1990's were the organosilicone, "super spreading" surfactants. This chemistry is excellent at very low rates for extremely fast spreading and penetration of solutions – however applied at higher rates it can be extremely phytotoxic if not abundantly watered in. In addition the organosilicone chemistries are hydrolytically unstable and rapidly degrade as pH drops below 7. For these reasons – this chemistry has not been widely used to manage soil water repellency. However, it remains an excellent spray adjuvant material.

Many factors contributed to the increase in products during this period. Increased use of wetting agents by turf managers resulted in companies recognizing a business opportunity for effective products. More research substantiating efficacy of some soil surfactants increased use as well. Distributor organisations with their own brands wanted their own wetting agent too. And with the original patent on AquaGro expired, and no new patents applied for in turf, it was a wide open market. In this sense the wetting agent market was like a generic/post patent market.

As mentioned, there are many block copolymer surfactant products on the market today – however their performance varies because all block copolymers are not the same. There are straight blocks and reverse blocks with varying molecular weights and chain lengths. Depending on the formulation, they have different effects on how water disperses or is held. In addition, the "blocks" are also rate dependent, i.e. different rates will give different levels of effect. As has been seen by Dr Letey and colleagues in the 1960's, Drs Beard & Rieke in the 1970's, Dr Karnok in the 1980's, and Dr J. Cisar, at the University of Florida, and others since the 1990's, even within the same general class of surfactants there are variations in performance based upon formulation, use rate and environmental conditions.

## Recent Innovations

Since 2000, there have been additional developments in soil wetting agent/surfactant technology, resulting in yet new performance options for turf managers. These developments have come from continued research by a few companies looking for improvements to existing block copolymer formulations and/or new and novel formulations with performance advantages to separate them from the pack.

Some developments have been simple but useful application changes, or program modifications. Others have involved formulation modification or the inclusion of additional. Still others have been novel enough to be eligible for patents – so there really is something new about them.

In the case of Dispatch, the patented technology involves combining certain block copolymer materials with another surfactant class – alkyl polyglucosides (APGs) – to create a synergistic effect which dramatically increases infiltration efficiency at very low application rates. In the case of OARS, a patented combination of an organic solvent and a surfactant complex is designed to remove accumulations of water repellent humic substances from soil surfaces. And in the case of Revolution, the new invention is constructing the block copolymer molecule with methyl caps which affects how the material orients itself on soil particles and influences water movement through the soil.

These newest formulations and the associated products take soil surfactants to a new level. While they have some familiar soil wetting agent performance characteristics, their novel formulations promise results that go beyond what has been achieved with previous products. From removing or overcoming the causes of problems in the case of OARS and Dispatch to allowing the rootzone to function hydrologically as intended in the case of Revolution, the new patented products offer a new level of control in managing the turf system. Time and use will show how real and important these new performance promises are. At this point, the information suggests that they are at least worth a try.

## The Bottom Line – What to make of it all

There has been a tremendous amount of research and development on soil surfactants for turf management since their introduction in the 1950s. This article has attempted to shed some light on their evolution through the decades. All soil wetting agents/surfactants have some things in common – some impact on how water moves across or through soil. However that's where the similarity stops. Different ingredients, different levels of active ingredients, and different application rates and frequencies make real differences in how these products perform in the real world.

So, the good news is that there are numerous soil surfactant products that are effective to some degree or another. The "bad" news is that there is no single clearly superior product for everyone. The practical news is that turf managers and advisors can evaluate needs and options on a case by case basis to determine which chemistries are likely to work best for them in accomplishing their goals.

To this end, turf managers can take a pragmatic approach.

First, assess the soil wettability and solute distribution needs at the particular location;

- Then, consider which companies and products have a history and performance profiles with supporting data, user experience and technical backing that suggest they can address the needs.
- Finally, try those products on site to determine which one or several are the best fit – agronomically, economically and customer support wise.

As with other product segments, the choices and capabilities of soil surfactants have evolved over time. What's best for you depends on the needs you have, the results you want and the resources you choose to employ.

For a full list of references and credits for this article please visit the BIGGA website - *bigga.org.uk*

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Starting to cut the 15th Fairway

# LIFE AS A QUAIL HOLLOW INTERN

*By Tom Granite*

**Having completed my degree in 2006 from Writtle College, I decided I needed to gain as much practical experience as possible.**

I had heard about the Ohio Program through college and trade magazines and wanted to find out more. I got in contact with Mike O'Keeffe (www.top.osu.edu) and went to meet with him in person at Harrogate Week. The programme brings young, 19-28 year old single turf applicants from around the world to the States for 12-18 months. You have to be drug free, have no criminal record and be willing to work hard while over there, if you want to be placed at a top club.

After speaking with Mike I decided to submit the forms as soon as I could. They were received by the end of January and I was starting at Quail Hollow by mid-March, so the whole process happened very quickly.

Once I arrived in Charlotte I was given a tour of the course and it was off to work. Luckily for me there were two Ohio State interns from Australia working at Quail; Simon Beilby had been there for a year and Patrick Casey had been there for two weeks. This was good for me as I had people who understood what I was going through and could show me the ropes and help me settle in.

Since 2003, Quail Hollow Club in Charlotte, North Carolina, has been home to the Wachovia Championship. The tournament has always attracted the best golfers in the world, with 30 of the top 35 taking part in the 2007 championship.

The course was originally designed by golf course architect George Cobb in 1961. In the intervening years, the course underwent a series of improvements, including modifications of several holes by Arnold Palmer in 1986 and a redesign by Tom Fazio in 1997 and 2003. The course is renowned for having the toughest three finishing holes on the PGA TOUR schedule for the past few years.

The championship traditionally starts around the first week of May and the preparation starts months in advance. As I arrived in mid-March preparations were well underway and I now have an understanding for the term "out of the frying pan and into the fire". From the moment I arrived we were working from dawn until dusk, at least six days a week in a high pressure environment, so I had to adapt to this very quickly especially as interns were given extra responsibilities and duties.

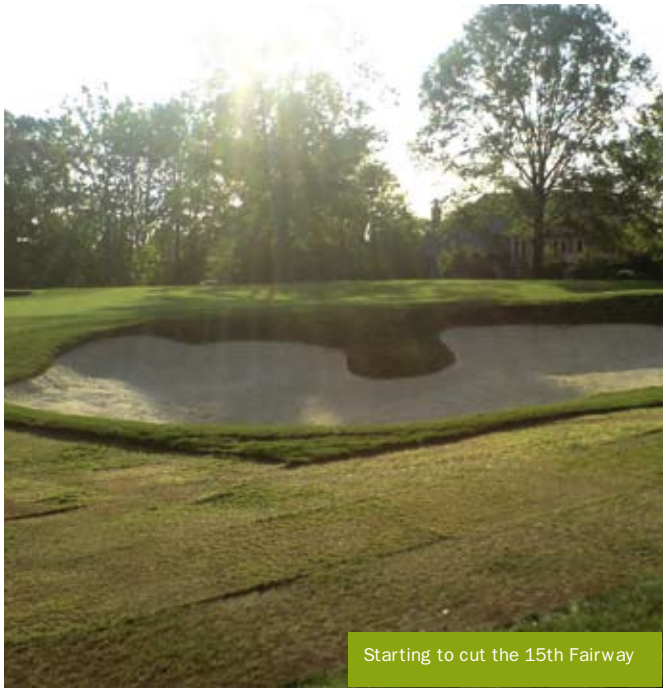
- Tournament Heights of cut
- Greens - .110 inches (2.8 mm)

- Tees, Approaches and Collars - .240 inches (6.1 mm)
- Fairways - .350 inches (8.9mm)
- Intermediate rough - .750 inches (19mm)
- Primary rough – 3 inches (76.2mm)

The greens are double cut in the mornings and once again in the evening. Everything else is cut once in the morning and once in the evening with the exception of the primary rough which is left. Approaches are rolled twice a day but the greens are not.

The largest area to be cut is the fairways which are approximately 30 acres. This is done in 45 minutes using up to 15 fairway mowers cutting in a "flying V" hole by hole in one pass.

To make it possible for all the cutting to be carried out in a short space of time (under three hours) a huge amount of machinery and staff is needed. During the tournament there were over 30 full time staff and up to 100 volunteers from all over the USA and even Australia.



Starting to cut the 15th Fairway

Drainage project on the 4th fairway

The machinery is supplied by Charlotte-based Jacobsen, who kept a steady supply of machinery coming in the weeks leading up to and during the tournament.

Machinery supplied by Jacobsen for the tournament:

- 8 greens mowers
- 9 fairway mowers plus 2 clean up mowers
- 12 tee/approach mowers
- 2 collar mowers
- 20 golf cars
- 14 mower trailers

This is only a small sample of equipment supplied; other machines include sand pros, rough mowers, flail mowers, utility vehicles and shuttles.

This is in addition to the equipment already owned by the golf course.

## The Transition

Charlotte is within the transition zone of the United States. This means that Quail Hollow has a mix of cool and warm season grasses including Creeping Bentgrass, Tall Fescue, Fine Fescue, Perennial Ryegrass, Bermuda grass and Zoysiagrass.

The day after the tournament has finished, work began on transitioning the course from cool to warm season grasses. This process includes scalping down the rough practically to the soil, in order to expose the Bermuda rhizomes.

The rough was predominantly Ryegrass and after the tournament was up to 12 inches high in places. This grass has to be scalped down and removed, using a combination of rough and flail mowers for the transition to be successful. It is important to remove the organic material to allow the sunlight to get through to the Bermuda and allowing the transition to happen as quickly as possible. The scalping of the rough was a very long and slow process, taking approximately one month to complete, with the mowers working non-stop through out this period.

## Bentgrass Maintenance

Throughout the summer, the maintenance of bentgrass greens in a warm season environment is an ongoing challenge. The greens were G2 bentgrass inter-seeded with A1 bentgrass. Heights of cut on the greens were maintained at .120 of an inch (3.05mm) during periods of heat over 38 degrees Fahrenheit. To prevent wilting of the turf we would syringe the greens when needed by putting out a light mist of water using a half inch hose. The purpose of syringing is to replace moisture lost by the plant through transpiration, but with out moistening the soil. In addition to the syringing, static and portable fans were used to cool the soil surface. The greens were only irrigated once a week, but this was done using a heavy application known as flushing. This would flush the greens of salts in order to keep the EC levels down. After the greens were flushed, the Sub-air system would be activated to move excess water out of the rootzone and into the drainage pipes. This keeps the playing surface firm and encourages deeper rooting.

Due to the difficult environment which we faced, an intense program of chemical and fertiliser was undertaken. This includes the use of many different fungicides to control a long list of diseases such as brown patch, dollar spot and pythium. Foliar fertilisers based on soil and tissue test results were also used on a regular basis along with the use of different plant growth regulators.

The greens are hollow tined three times a year, once in early spring,