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would have done the same," said Ken.

Part of the project is the re-designing of the 6th and 7th holes, which have long been recognised as the weakest on the course. They had been a late addition in the late 80s and early 90s, following boundary issues and the removal of other holes on the edge of the course, but restrictions in place at the time meant there was a limit to what could be achieved by the replacements.

John Nicholson has been instrumental in ensuring that the work required to create the new holes is in keeping with the heathland/moorland nature of the rest of the course while at the same time conforming to Forestry Commission demands.

The new holes will benefit from the removal of trees and the introduction of heather which will open up the holes in keepi ng with the other 16. The new bunkering will also blend in with the others.

Indeed, a couple of days earlier a beech tree had been removed from the side of the 7th green and replaced with wonderful new bunker.

"The club acquired a felling licence last year and we work closely with the Forestry Commission to ensure that they are comfortable with everything that is being done," explained John, who also has some interesting views of gorse.

"The reason we've got gorse on these courses is that it was introduced in the Middle Ages as fodder for livestock. Women and children collected it in the summer and made it into a rich porridge for their animals. It was man-made and imported from Spain and it has become very invasive and is now probably the biggest danger, along with trees, to the heathland/moorland environment," he explained, adding that they had already taken out a lot of gorse at Moortown.

When assessing a site John considers the agronomic, strategic and the ecological elements but there is another issue which takes precedence.

"The genius loci – the spirit of the place – is what you've got to assess on day one. You've got to take on board that whatever we do has to be in keeping with the landscape."

As we spoke the construction work was around 50% completed but Steve was well aware that it would take time for the results of much of what has been done to come through.

"Members do appreciate that trees can have a negative impact on keeping and introducing heather, but they also think that once the trees have been removed the heather will come back on its own.

"They don't always realise that the tree removal is only the first stage and that it still requires work to bring back the heather. We scrape back the soil to expose dormant heather seed, some of which have been buried for 80 years.

"You can be looking at a mini-

INSET BELOW: The 7th (before) and MAIN RIGHT: the 7th as a photomontage for the new design, being held up by Ken Moodie (MAIN BELOW)

"After visiting MacKenzie courses, Cypress Point and Pasatiempo Golf Club, in California, and seeing the restoration work that has been done on those courses, we wanted to do the same with Moortown"

Ken Moodie, Architect (left) who is remodelling the 7th hole (as shown)

mum of two to three years before you see results. It's not like growing grass," said Steve, who has learned to highlight out of play areas for the initial plots.

"If you choose areas in play which are then GUR for a long period of time you will get members coming up to you in 18 months saying, 'It's still not happening, forget it. It's not going to work'," said Steve, who carries the confidence of knowing that similar work at Blackmoor produced the results and that patience is rewarded.

So what does the third man in the Ken Moodie, John Nicholson, Ken Brown partnership think.

As the only one to have actually played in a Ryder Cup Ken brings a professional golfer's eye to a project, and the experience of having broadcast from 100s of the world's finest golf courses.

"There are three ways of undertaking a project – restoration, renovation or revolution – but by far the best approach is restoration," said Ken, who was key in determining the position of the bunkers on the two redesigned holes.

That is a task which is not as straightforward as the average golfer may believe as Ken is very aware that the one piece of kit not possessed by any golfer or architect, but which would make life much easier, is a crystal ball.

"You have to look ahead and anticipate how far the ball might be travelling in 20, even 50, years time but that will be determined by a combination of technology and regulation, and really no-one can know for sure.

What we do know is that the tees at many clubs have been pushed right back as far as they can go, but if we were to plan for today, bunkers could be in the wrong place tomorrow and we have to do what is best in the long term interests of the golf course."

We often come across situations where golf club members have made decisions on the golf course and while a lot of them are good ideas, it can be more haphazard than bringing in professionals, who can take all considerations on board," explained Ken.

John Nicholson

Steve Robinson, BIGGA Member for 18 years

With its rich heritage and unique link with the Ryder Cup the Moortown members have taken the decision to embrace the professional advice they have been given.

Those interested in all things Ryder Cup, who choose to visit Moortown in this year of the latest match, will receive a warm welcome as well as a wonderful opportunity to play an updated version of the course which faced Cotton, Duncan, Sarazen and Hagen.

Moortown GC Clubhouse

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Turf fertiliser...a question of balance and perspective

Dr Terry Mabbett looks at the elements and nutrients that are required for healthy turf

The increasing scope and spread of turf fertiliser in concept and composition is of general benefit to grass and greenkeepers alike. New considerations have nudged the industry away from reliance on traditional short-term, stand-alone quick fix solutions scooped out of the sack, into a longer-term and more broadly based holistic approach.

Being in harmony with the complexity of subterranean and soil surface bio-systems and food webs concentrated in the root zone and thatch is the name of the contemporary game in turf grass nutrition. Soil associated food webs deliver plant-available nutrients in a natural and therefore measured and sustainable way.

Attention paid to pathogenic microbes and invertebrate pest animals has re-focussed onto environmentally friendly relatives which if present in sufficient number and the right balance, goes the argument, help to neuter 'nasty' turf grass pathogens and insect and nematode pests. Essential plant nutrients released at key points around the food web and immediately available to grass roots is the complementary and interactive benefit.

Plant nutrition the natural way

Fertilising with the flow of natural soil bio-systems should underpin the nutrition and health of any grass sward whether amenity or agriculture. They incorporate friendly fungi such as mycorrhizae, saprophytic and antagonistic fungi, beneficial bacteria including decomposers and entomopathogens [parasitic on insect pests] and other microbial decomposers (protozoa), and the host of invertebrate animals (insects, other arthropods, molluscs, annelids [earthworms] and nematodes), both plant feeders and entomopathogens, most of which chomp away on organic and/or mineral matter and thereby contribute directly or indirectly to improved soil structure and fertility.

Natural soil bio-systems occur and operate at full power in well-structured fertile loams, but the substrates used to establish and support most golfing greens are far

MAIN ABOVE: spring fertilizer applications to turf should contain an elevated proportion of phosphorous for solid and sustained root growth

INSET ABOVE LEFT: Wheat a close relative of turf grass was one of the first plants to 'flag up' sulphur deficiency symptoms following the big industrial clean-up some three decades ago.

INSET LEFT: You only have to investigate the composition of surface worm casts on greens and tees to see just how much sand there is below ground

Another case of how spring fertilizer aapplications to turf should contain an elevated proportion of phosphorous for solid and sustained root growth

from this description. Golf greens are established on high sand substrates for free drainage. You only have to investigate the composition of surface worm casts on fine turf to see just what a high proportion of sand there is below.

If a sand-based substrate is unable to support the full spectrum and activity of soil associated biosystems and food webs then the benefits derived are accordingly reduced from what was perceived and anticipated. Soil supplements as humate derivatives act as reservoirs of nutrients and vehicles for their delivery and availability and uptake through bio-stimulatory effects on soil microbes and grass plants. However, without an inherent and appropriate soil structure there is a limit to what they can achieve.

Losing the essentials of plant nutrition

New concepts in turf grass nutrition and health are becoming as complex as the food webs they aim to flow with and here lies a danger of losing sight of the critical importance of individually essential plant nutrients for healthy growth and development, whether of bent grass or beech trees, through 'not being able to see the wood for the trees'.

Turf grasses are simple green plants but do the job they are designed for, creating a uniform planar and cushiony playing surface which is easily and effectively maintained because turf grasses respond well to frequent close cutting. Grass is a chlorophyll-containing plant that traps light energy and converts it into chemical energy for growth and maintenance via a complex series of enzyme controlled reactions collectively known as photosynthesis. This requires a portfolio of plant nutrients, each essential in its own right and as part of the whole in balance with others.

At the end of the day it doesn't actually matter what form of fertiliser is used, and how it is applied, because if the grass sward cannot access the full portfolio of plant nutrients in the right quantities and balance it will fail to perform as professional turf.

Essential turf grass nutrients

Essential nutrients for green plants like grass are macronutrients (Nitrogen [N]; Phosphorous [P]; Potassium [K]) or micro nutrients (Zinc [Zn]; Copper [Cu]; Iron [Fe]; Molybdenum [Mo]; Boron [B]) depending on the exact quantity required for optimum grass growth

Iron is ideal for a 'lean and mean' green up in winter

The soil dimension can be side-stepped by spraying nutrient solutions in a foliar feeding programme

and development. In the middle are several other essential nutrients such as Sulphur [S], Calcium [Ca], and Magnesium [Mg] sometimes referred to as secondary nutrients. These are required in much lower amounts than macronutrients but in considerably higher quantities than micronutrients, which are alternatively called trace elements.

The portfolio of plant nutrients essential for optimum growth, health, vigour and resilience of turf is generally well known, but less well appreciated is the profile of its functions. The best way to appreciate the role of each essential plant nutrient is to recall the reasons why greenkeepers have traditionally applied a particular nutrient during a particular season or at a specific time during the golfing calendar, or equally why they have not.

Nitrogen applications in autumn provided they are well-balanced with potassium should not lead to excessively soft lush growth

Nitrogen – the succulent growth and green up nutrient

Nitrogen is required in greater amounts than any other nutrient. On a dry weight basis (grass dried to zero moisture) nitrogen accounts for 3-5% of plant matter. Nitrogen is at the very heart of grass plant genetics and physiology being a component of DNA, chlorophyll and every single amino acid used to build proteins for growth. Effect of nitrogen application is accordingly fast and furious with plants assuming a rich dark green colour and a spurt of vertical shoot growth.

Nitrogen promotes leaf growth and enhances turf density by promoting tillering. When balanced with phosphorous, nitrogen boosts root development and turf recovery from wear and tear. Autumn applications in balance with potassium produce overall growth that should be sufficiently tough to withstand winter conditions.

Phosphorous – the anchorage element

Phosphorous is the 'anchorage' element spurring on root growth and development. Phosphorous is generally required in only limited amounts but more liberally when new turf is established by seeding or laying sod.

Phosphorous is important early in the season when turf responds quickly and substantially to warmer temperatures and therefore requires rapid and sustained root development to anchor and underpin rapid spring shoot and leaf growth. NPK formulations used at this time should have relatively high ratios of phosphorous.

ABOVE: Compacted soils and nutrient loss from run-off pose high risks for water courses

Potassium – the gatekeeper

Potassium is commonly called the 'gatekeeper' nutrient because it controls the opening and closing of stomata on grass leaves and therefore the amounts of water lost by transpiration and carbon dioxide diffusing in for photosynthesis. Sufficient potassium is essential for good drought resistance. Potassium hardens turf against adverse conditions whether summer heat and drought, or winter cold.

Calcium – the strongman nutrient

Calcium pectate cements plant cell walls to form plant tissues and is therefore central to the structure and anatomy of turf grass plants. Together with magnesium, potassium and iron, calcium is known as a hardening and resilience nutrient.

Magnesium – the lightening conductor

Magnesium literally at the centre of the chlorophyll molecule is correspondingly central to photosynthesis. Without magnesium there is no chlorophyll to trap sunlight leaving grass without its natural rich green colour and the ability to power its physiology.

Sulphur – the forgotten nutrient

Sulphur was often called the 'forgotten' element because greenkeepers (like farmers) traditionally received free sulphur spewed from power-station and factory chimneys. The 'de-greening' of plants, which rapidly became deficient in sulphur, rapidly followed the 'greening' of industry. Yellowing symptoms were confused at first with nitrogen deficiency. Wheat, a close relative of the turf grasses, was the first to signal this change and show sulphur deficiency symptoms.

Iron – the lean and mean green-up nutrient

Major roles in chlorophyll synthesis and nitrogen metabolism allow iron to green up turf without the soft succulent leaf and shoot growth associated with nitrogen. Iron is therefore ideal as an autumn or winter turf tonic.

Copper, zinc and manganese – the enzyme co-factors

These are classic metallic micro-nutrients required in trace amounts as co-factors for optimum activity of specific enzymes. Copper

Late summer and long shadows is when soil compaction is most evident and the risk of nutrient loss and especially nitrogen, from run-off is correspondingly high.

is a co-factor for the enzyme polyphenol oxidase.

Boron – the meristem minder

Boron is one of the most 'micro' of all micronutrients but nevertheless plays a critical role in ensuring rapid sustained cell division in apical meristems where shoot and root growth occurs.

Molybdenum – the metabolism maker

The micro-nutrient with major roles in both nitrogen and phosphorous metabolism

By-passing the soil

The soil is a dangerous place for plant nutrients and an obstacle-strewn course illustrated clearly by the potential fate of the three macronutrients (N, P and K). Nitrogen can be applied and made available as either NO3- or NH4+. NO3- as a negatively charged anion. It is not attracted to soil colloids and therefore cannot be held and stored on cation exchange sites. Cation exchange sites are in relatively short supply in the typical sand based soils that support professional sports turf.

High permeability of sandy soils coupled with a relatively low cation exchange capacity means nitrate is prone to heavy leaching. Heavy traffic building up through the season, coupled with progressive drying out, means summer soils can become compacted with a water impermeable pan. Heavy summer rain, or irrigation, run off the surface carrying any soluble nitrogen along with it.

Phosphorous availability is very susceptible to changes in soil pH. When pH levels fall below 6 (increasingly acid), or raise much above 7 (becoming alkaline), soil phosphorous becomes 'fixed' (tied up) and unavailable for uptake by grass roots.

Clearly there is not much leeway and phosphorous unavailability is one of the first casualties of inappropriate liming.

Potassium levels in soil under turf should be monitored closely and topped up as required because the positively charged cation (K+) is particularly prone to leaching from sandy soils with their inherently low cation exchange capacities.

There is one easy way to avoid all these potential hurdles to soil nutrient availability – reach for the bottle instead of the bag and opt for foliar feeding by spraying with an appropriate nutrient solution.

Compacted soils and nutrient loss from run-off pose high risks for water courses

Fertiliser in balance and perspective

Turf managers should always go as far down the 'fostering the food-web' track as possible, but not rule out the use of rapid remedial action where necessary.

Sports turf is a completely unnatural ecosystem both above and below ground and correspondingly less able to maintain long-term stability both nutritionally and in health without at least some short-term quick fix interventions.

Fertilisation of turf is all a question of balance but in more ways than one.

Applied plant nutrients should always be in balance with each other, according to their intrinsic relative status and turf r equirements at particular times of the calendar year and golfing season.

Everything should be done to maintain the natural biological balance in the root zone and thatch while being prepared to weigh this up with quick-fix interventions if necessary, and avoid being convinced that everything out of a bag or a bottle is bad.

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Nematodes in turf

Graham Paul offers you the chance to collect some BASIS points and learn some information on nematodes, the plant parasitic nematodes that affect amenity turf

Nematode as seen through low power microscope

If you have ever seen damage on turf that doesn't fit in with the symptoms of disease, animal or insect attack, then you may have experienced the effects of a nematode infestation.

Nematodes are round worms that belong to the phylum Nematoda - the second largest group of invertebrate animals after the Arthropods (Insects and bugs). Over 80,000 species of nematodes have been described but scientists believe the total number of species on this planet exceeds one million! They occur in a wide variety of habitats existing as both free-living and parasitic species.

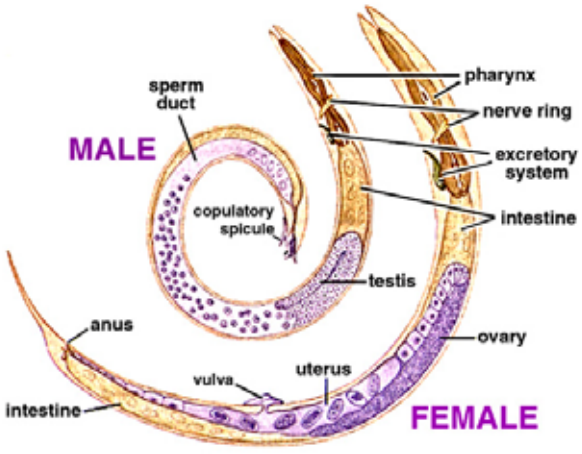
This article will concentrate on the plant parasitic nematodes that affect amenity turf.

The majority of nematodes are free-living, existing on a diet of dead organic matter. Pathogenic species are known to affect most forms of macroscopic life – including plants, animals, birds, fish, crustacea, insects and bugs.

Most nematodes are so small that they cannot be seen without a microscope or strong hand lens. They are un-segmented and at the anterior (head) end there is a mouth with three lips and armaments, which may include; teeth, hooks, a spear or stylet.

The nematode body consists of a long hollow tube with another tube inside it, containing the alimentary canal and reproductive organs. The body shape is maintained by holding body fluids between these 'tubes' under pressure (1.4 to 2.4 p.s.i.) A muscular pharynx is needed to propel food through the intestines, which tend to collapse under the force of the internal body pressure. The nematode has no blood circulatory system but it does have a fairly well developed nervous system. There are only longitudinal muscles, so they move with a 'snake-like' whipping motion.

Nematodes species often have both males and female sexes but it is not uncommon for plant parasitic nematodes to reproduce asexually by parthenogenesis – a process in which the unfertilized ovum develops directly into a new individual. Most of the nematode's body cavity is taken up by reproductive organs. Females are typically larger than males, since the production of thousands of eggs takes up much more body space than the creation of sperm by her partner.



ISNET ABOVE: Diagram 01 - Anatomy Of The Nematode – see acknowledgements

RIGHT PAGE: Nematode eggs
Courtesy of Dr Ruth Mann, STRI

The male introduces sperm into the females vulva with the help of two horny, stiff spicules that are part of his cloaca. Fertilisation is internal and the female lays her eggs over a prolonged period of time. Some species can lay eggs at the rate of 200,000 per day. The eggs hatch and go through four moults before the adult stage is reached.

Almost 4100 species of plant parasitic nematodes have been