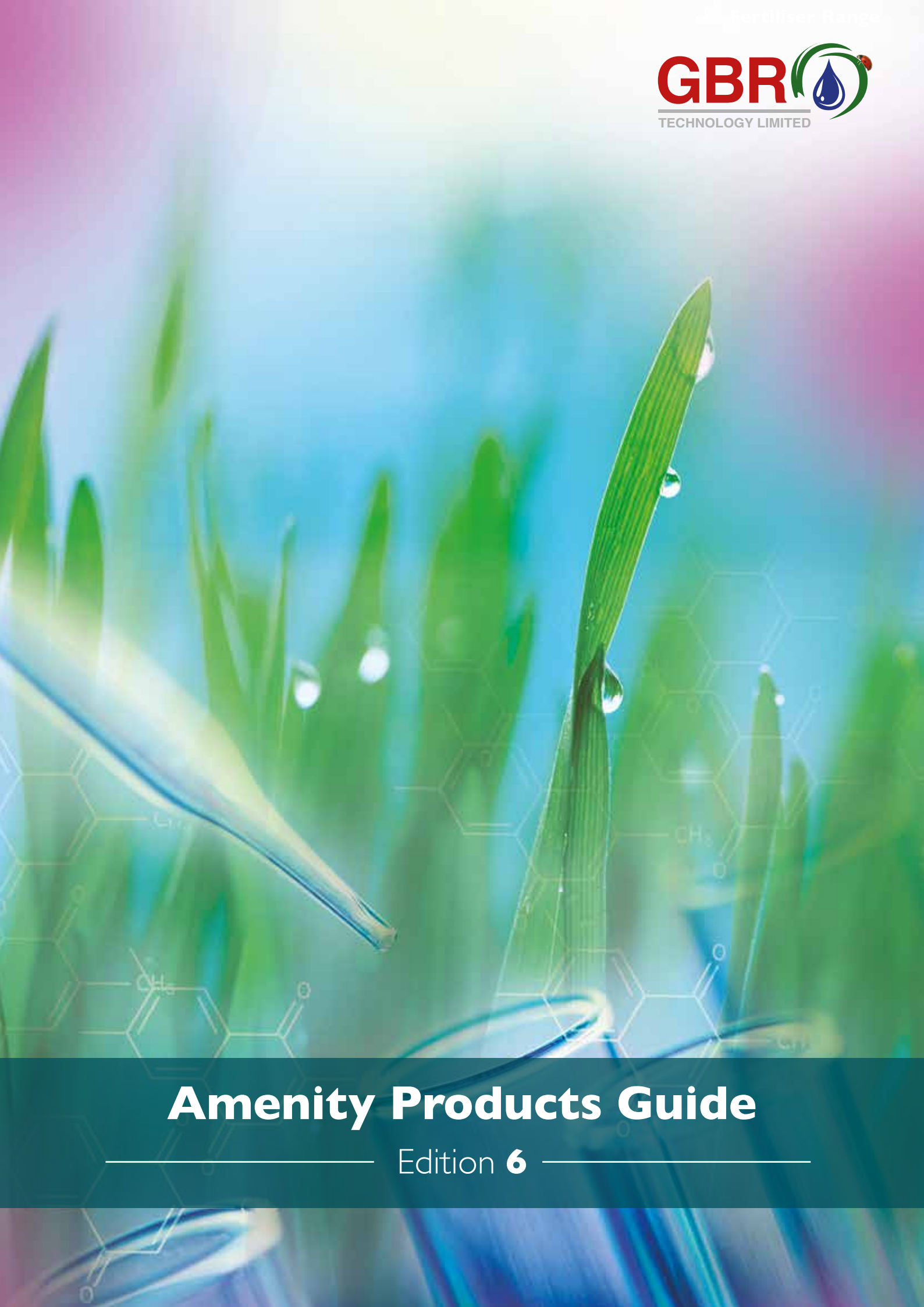
Fertiliser Range

GBR
TECHNOLOGY LIMITED



Amenity Products Guide

Edition **6**

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GBR TECHNOLOGY LIMITED

Welcome to our *Product Guide*

About us:

GBR Technology Limited was formed in 1993 as a fluids off-shoot of CVC Scientific, which itself has roots directly traceable through Bendix, Bell and Howell and further back to the Eastman Kodak Corporation in 1934. Our lubricants heritage diversified in 2009 when we offered our first non-lubricant products to the sports turf market. Since then our range has expanded significantly. We develop and manufacture an increasing range of products in-house and these are enjoying an excellent reputation for quality and performance in the market. GBR Technology produce many of our own brands which are sold direct and via our valued distributor partners who we support closely. We also manufacture products for other sports amenity customers with tailored products going to market under a variety of brands. As an independent and successful company with formulatory and manufacturing capability we are able to provide good flexibility in meeting our customers' needs and expectations.

Our focus is on quality, continuous improvement and giving our customers the best possible service and technical support. On pricing we seek to be competitive, offering excellent products with a quality for price characteristic that is highly attractive.

Our products are used with great success across an increasing number of the worlds' best golf courses and sports venues. Our reputation is backed up by our ISO 9001 quality standard accreditation giving you peace of mind in our operations, processes and procedures. Based on the Hampshire/Berkshire border we have a spacious modern facility comprising our offices, warehouse, production area and laboratory on one site.

Our People:

GBR Technology have technical amenity sales staff covering England, Scotland and Wales. With good experience between them and BASIS qualifications, we're confident you will get excellent quality advice. Our back office team is first class from warehouse and production operations to sales order processing to accounts - we are confident you will find dealing with us a pleasure in the vast majority of cases. Sometimes things do go awry, for instance goods damaged during transit, in these cases we'll do our very best to resolve things to your satisfaction as fast as we possibly can.

Delivery:

In the majority of cases orders are dispatched within a day or two of receipt of order even during peak season. If you need an urgent delivery we'll do our best to accommodate this. Some items come from third parties and may at peak season have a longer lead time – this is mostly confined to fertilisers. GBR dispatch to customers throughout the UK and globally – we've been exporting products for over 20 years.

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Articles:

Our operations

Our expertise covers formulatory skills, production, warehousing, marketing, sales, technical support and supply to end-users in the UK and globally. We employ a number of chemists qualified to degree level and we have many years combined experience of laboratory formulation of surfactant based products leading to successfully established products in the market.

We maintain a laboratory equipped for product development and initial testing of formulations before they go for field trial.

Successful innovation does require working closely with raw material suppliers, other partners and end-users and we are proud of our working relationships, which are vital to our business.

Our production operations are continually expanding and are currently equipped for the blending of liquid formulations in batch sizes from 20 litres to around 5 tonnes and temperatures up to around 100 degrees C.

We hold the ISO 9001 quality standard as required by a substantial amount of our customer base and this is our independently verified commitment to quality in our operations, giving many of our customers additional peace of mind in dealing with us.

Follow us on Twitter for up to date news, developments and offers!

@GBRTechAmenity

... our
Wetting Agent Range

Introduction

With an in-depth knowledge of surfactants, this is one of our core areas. At GBR Technology we have amongst us many years experience of hands on formulating and real world use of surfactant based products. We both formulate and manufacture products in-house, selling direct and via re-sellers and distributors.

Our scope for these products now extends to overseas sales. With a reputation spreading for 'best in class' products, service to match and an impressive and dedicated technical sales team, our already well established customer base continues to grow rapidly.

The Benefits of Wetting Agents

As well as the key property to prevent localised dry patch (which can affect play) on putting surfaces, wetting agents have a whole host of other benefits that can improve turf health and the general condition of the course and can also assist with making the best use of available water – giving a more even spread, reduced run-off and loss through preferential downward flow and entrapment in thatch layers (especially on turf containing greater amounts of stolons and rhizomes).

The benefits of wetting agents can include all of the following:

- Eliminate or reduce localised dry patch
- Recovery from localised dry patch
- Reduced water run off
- Reduced level of pollutants reaching water courses
- Reduced evaporative water loss
- Reduced downward percolation of water through channels of preferential flow
- Reduced leaching of nutrients
- More homogeneous and consistent conditions across greens
- Increased uptake and effectiveness of applied nutrients
- Enhances the recovery on non-irrigated fairways suffering drought stress when rain does arrive
- Reduced water holding on spongy thatch layers
- Alleviate or remove anaerobic conditions resulting from saturated thatch
- Help create the right air and moisture levels for aerobic microbes to thrive

Properties of Wetting Agents

The surfactants used in formulations need to effectively lower interfacial tension to allow good wetting, so the ability of a surfactant to lower surface tension (more accurately interfacial tension) is an important property. Once the surface tension of water is below the surface energy of the surface to be wetted then ready wetting will occur on contact. Different surfactant chemistries have different abilities to lower the surface tension of water. For monthly residuals, the ability of the product to keep working between applications is a key performance differentiator - surfactants deplete over time though biodegradation and water washout, however depletion can be significantly reduced if products are formulated with this in mind.

Soil and Rootzones

Soil contains a significant amount of air in its pore spaces. The pores can be considered to be capillary or non-capillary pores. Capillary pores are the smaller pores and spaces where the movement of water is significantly affected by cohesion (surface tension) of the water and the adhesive forces from contact with soil constituents. In the non-capillary – macro pores, the movement of water is more influenced by gravity (which also generates hydraulic forces).

Certain key levels of moisture content have been identified:

- Saturation – both capillary and macro pores are filled
- Field Capacity – capillary pores essentially filled with water but macro pores filled with air
- Wilt point – water present in soil is at such a low level that the grass plant starts to wilt and die

Field capacity is an ideal point to reach with sufficient water available to support the health of the turf but with the soil nicely aerated. Field capacity allows enough moisture for evapo-transpiration and should also allow free diffusion of oxygen and carbon dioxide – this will also encourage aerobic micro-organisms and these are efficient at breaking down many forms of organic matter and thatch.

Between field capacity and the wilt point the grass plant gets to a point at which it is said to be coming under increasing moisture stress.

Filling the capillary porosity of the soil with water to field capacity or just under is a desirable state. The use of wetting agents can lower interfacial tension and render more capillary pores 'wettable'. Build-up of hydrophobic material could otherwise render areas of the rootzone difficult to wet.

If we consider a sandy rootzone we would normally expect this to be very readily wetted by water alone – sand is a form of silica and has a high surface energy and thus can be readily wetted. However, hydrophobicity can arise from a number of sources:

- Plant breakdown material (especially under anaerobic conditions)
- Insect material and its decomposition
- Animal droppings and its decomposition
- Fungi

The use of wetting agents can over-come this hydrophobicity.

The Flow and Fate of Water

Models exist to describe the flow of water in soils but are different dependent on whether it is saturated flow, unsaturated flow or vapour movement. The reality is then that in many instances the flow of water is quite complex and when surface run off, surface evaporation and evapo–transpiration through plants is considered along with how this can alter throughout the season and with different amounts of irrigation and rainfall, then the real world behaviour can be quite variable.

Wetting Agent Range

In many cases though, surface run-off and downward percolation by gravitational flow can lose significant amounts of water (and also result in leaching of applied chemicals – including into water courses) and the use of wetting agents can significantly reduce these losses. Bear in mind too that water held on foliage or upper thatchy layers does not support plant growth and will evaporate directly into the atmosphere.

Water held in saturated thatchy layers will also dramatically reduce oxygen and carbon dioxide diffusion with the rootzone underneath – this can then adversely affect the populations and activity of beneficial aerobic microbes in the soil.

The effects just described may affect sand based rootzones to a different extent than fairways and steeply inclined courses differently to those with less variation in elevation. The benefits of wetting agents will vary across different parts of the course and under different conditions but a discussion with one of our technical sales team should offer a beneficial insight, possibly with some practical demonstrations which may help you decide how best to use wetting agents for your application.

Types of Wetting Agents

Wetting agents can be formulated to reside in the soil for prolonged periods of time – a common term for these is 'residuals'. They tend to be higher molecular weight, longer chain, molecules and are the mainstay of most wetting agent programmes.

The terms 'penetrants' is ascribed to wetting agents that are generally of lower molecular weight, greater water-solubility and greater surface tension reducing property – they may be short lived in the soil profile but increase the ability of water to penetrate further into the rootzone.

Rather than dose surfactant into the soil, another method is to reduce the surface tension of applied water before, or as it is, applied. Wetting agent pellets, or irrigation tank tablets can achieve this, however they do not of course reduce the

surface tension of rain falling onto the course!

Surfactants can be very effective at reducing surface tension of water even at very low concentrations. Even 1 part per million can reduce the surface tension of water from around 73 dynes/cm to around 45 dynes/cm and 1 part per hundred thousand can get down to around 40 dynes/cm. 1 part per hundred thousand is equivalent to a 3kg irrigation tank tablet dissolved in 300 cubic metres of water and may be a good level to aim for.

The table below categorises our range of wetting agents according to type:

Product type classification	Product
Monthly residual	Formulation 42, Hydrozone, Aquazone, Influxer, Influxer Excel, Dewel
Penetrant	PenetraX, Intensive Wetter, Influxer, Influxer Excel, Formulation 42, Hydrozone, Eco-Wet, Dewel
Hose end pellet	Aquazone Pellets
Irrigation tank tablets	Aquazone Irrigation Tank Tablets
Combined dew dispersant and residual	Dewel, Influxer Excel

Use rates and Timing of Wetting Agents

Greens

A good monthly programme is preferred during the main growing season. Susceptibility to dry patch varies course to course and also depends strongly on weather conditions.

Treatments of Aquazone at 15-20 litres per hectare monthly or Hydrozone at 10-20 litres per hectare monthly from March/April till September/October is the norm. For Formulation 42 the treat rate is 12.5L/Ha monthly. Treatments at 50 litres per hectare every 3 months can be used instead if spray time is very limited, although a monthly programme at the rates indicated is preferred.

In the winter, the use of Influxer at 10 litres per hectare or Intensive Wetter at 1-3 litres per hectare can help take water away from the top surface and can also assist in charging the soil profile with water ahead of the main growing season. PenetraX can be used at 5L/Ha and gives greater longevity.

Intensive Wetter can also be used as a 'curative' on greens to assist in washing hydrophobic material out of sandy rootzones. In order to be effective, Intensive Wetter should be applied at 3 litres per hectare and watered-in with 10mm of water. After a period of 10-30 minutes, a strong water flush should be applied to the area by hand watering with particular focus on any especially hydrophobic areas. Bear in mind you are essentially 'washing the rootzone'. Intensive Wetter will need to be washed into the rootzone, allowed a period of time to start to emulsify some of the hydrophobic material and then this emulsified material dislodged or flushed through with a strong flush of water. Cleaning power is often expressed by the following equation:

Cleaner power = (chemical action + mechanical action + heat) x time

In this case the Intensive Wetter provides the chemical action and the mechanical action is provided by the hand watering (and thus flow of water through the rootzone) – we have no control over heat in this instance!

Tees

Tees can be treated with Aquazone, Hydrozone or Formulation 42 in the same way as greens although as this is not a putting surface it is not uncommon to apply 50 litres per hectare every 3 months.

Fairways

Wider variety of treatments are encountered on fairways. With a much larger area to treat, then the cost becomes a more significant issue in the vast majority of cases. Also, the availability of irrigation is another key consideration. Spraying the fairways is also much more time consuming, requiring significantly more than one tank to cover a typical 10 hectares of fairways!

The very best option is application of Hydrozone or Aquazone at 50 litres per hectare every 90 days during the growing season. Aquazone has an advantage in that it is more cost effective and can be tank mixed at up to 12% concentration. The task can thus be completed with under half the number of tanks than with most products – saving a significant amount of time.

However 50 litres per hectare would not be in most clubs budget and significantly lower treat rates (down to 7 litres per hectare) will still give benefits and a useful degree of residence time.

Intensive Wetter can also be used at 1-3 litres per hectare for a short but very effective 'restorative hit' – it will get water in to hydrophobic areas and is a great choice to apply ahead of rainfall – PenetraX will also achieve this and will work for longer.

In many cases of applying wetting agents to non-irrigated fairways in a cost effective manor, then using the appropriate product ahead of significant rainfall, a few times a season can be very worthwhile. If turf stress is already very evident on fairways, then again the right wetting agent ahead of a downpour can make a big difference to restoring turf health.

If in any doubt please speak to one of our technical sales team who can help you decide on the best options for your own particular needs.

Wetting Agent Range

FORMULATION 42

Uniquely Advanced Wetting Agent – Residual & Penetrant

Formulation 42™ is a highly advanced wetting agent – residual and penetrant - for use at 12.5 litre per hectare giving 10L/Ha of residual wetters and 2.5L/Ha of penetrant wetters.

Residual wetters: A uniquely optimised blend of surfactants designed to take wetting property and longevity to a new level.

Penetrant wetters: Employing a unique penetrant engineered to last longer in the profile, combined with a superwetting surfactant for maximum wetting power and the ability to disperse water and dew from the leaf for a period.

Through our knowledge of surfactant technology, Formulation 42 achieves a new level of optimisation of block copolymers used for monthly residual wetting. The absolute wetting performance is further enhanced along with the resistance to both biodegradation and water washout. Extensive trials have confirmed a reduced treat rate of 12.5L/Ha.

One of the significant advancements of Formulation 42 is a unique penetrant wetting agent designed to last longer in the profile through its resistance to biodegradation.

Benefits and Features

- Highly optimised residual wetter
- Creates more homogeneous conditions across a green
- Allows prevention or reduction of localised dry patch even under conditions of increased moisture stress
- Allows recovery of areas already suffering localised dry patch
- Reduces soil hydrophobicity
- Long lasting penetrant designed to cope with heavy rain fall to give quicker infiltration rates and alleviate standing water

Application

Apply monthly during the growing season typically from March until September or October. For use at 12.5 litres per hectare giving 10L/Ha of residual wetters and 2.5L/Ha of penetrant wetters.

Formulation 42 should be added to water and applied by spray.

Pack sizes available

5 litre, 12.5 litre, 120 litre, 200 litre drums, 500-1000 litre IBCs

Monthly application:

Zone	Formulation 42	Water Volume	Area	Notes
Greens	12.5 litres	300-600 litres	1 hectare	During prolonged hot conditions (day time temperatures of 26°C and above for longer than 10 days) apply at 17.5L/Ha monthly or 12.5L/Ha every three weeks.
Tees/Sports Pitches	10-12.5 litres	300-600 litres	1 hectare	
Fairways	5-12.5 litres	200-600 litres	1 hectare	
Bowling Greens	1.5-1.9 litres	45-90 litres	1500m^2	

During prolonged hot conditions (day time temperatures of 26°C and above for longer than 10 days) then apply at 17.5L/Ha monthly or 12.5L/Ha every three weeks

Other application rates:

Zone	Formulation 42	Water Volume	Area	Frequency
Fairways/Tees	25 litres	300-600 litres	1 hectare	90 days
Do not exceed a solution strength of 6%				

Pack sizes available

5 litre, 12.5 litre, 120 litre, 200 litre drums, 500-1000L IBCs

Formulation 42™ Granular

A slow release fine, greens grade granule impregnated with Formulation 42 - the most advanced, 100% active residual wetting agent with curative properties on the market. The zeolite granule carrier continues to enhance the CEC of the rootzone long after the surfactant has been released. A granular wetting agent where everything is beneficial and nothing is wasted.

Benefits and Features

- Slow release for greens
- Zeolite granule enhances CEC of the rootzone

Pack sizes available

15kg Tub

Monthly application:

Zone	Formulation 42 Granular	Area
Greens/ Fairways/Tees Sports Pitches	150-500kg	1 hectare
Bowling Greens	22.5-75kg	1500m^2

Discussion around application rates:

For monthly residual products of 100% activity (i.e. no diluents in the formulation) then typical application rates on greens and sports pitches is 10-20L/Ha monthly, with most programmes running at 20L/Ha. The rates are designed to give sufficient wetting power to the soil over the period (and a bit of leeway should be built in too) and are chosen considering the breakdown and washout of the surfactant over time.

Once applied, surfactants will biodegrade in the soil and under very wet conditions can also wash out. During most summers the main rate of depletion is expected to be biodegradation rather than wash-out – since evapotranspiration rates are sufficiently high that in most cases the wetting front does not extend down so far.

Biodegradation rates are high in the summer – with higher temperatures, many surfactants will degrade quickly in the soil becoming a food source for microbes. When microbes are active, the biodegradation they give rise to is essentially a chemical process and typically reaction rates double for every 10^{o}C that the temperature rises.

For the south east of England we might expect on average that a wetting agent doesn't last as long as say an elevated course further north (due to both the height and latitude bringing down the average temperature).

Formulation 42 achieves a new level of optimisation with regard to the absolute wetting power of the tri-block copolymer components along with a new level of optimisation in the resistance to biodegradation and water washout. This means better wetting ability and greater longevity. In the 12.5L/Ha rate – this gives 10L/Ha of residual tri-blocks and again is designed to be a safe level with some excess built in.

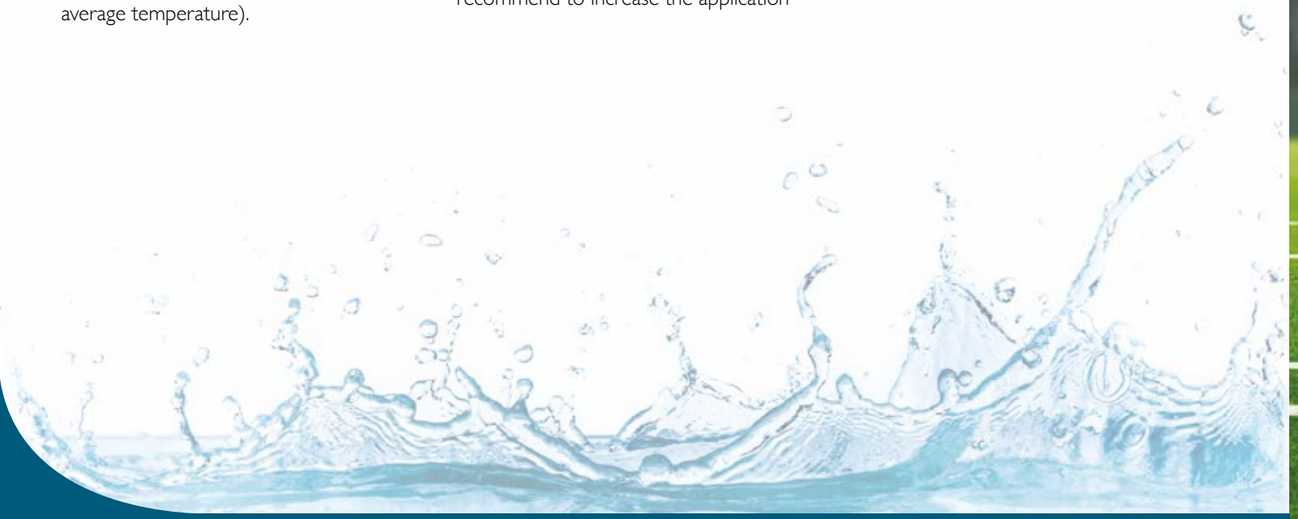
Another innovation in Formulation 42 is a penetrant blend with a unique twist. Penetrant surfactants are generally shorter chain and more soluble than residuals and they tend to biodegrade quite rapidly when in the soil. This combination means high rates of water washout and a much shorter residence time for penetrants due to rapid biodegradation. Formulation 42 contains a penetrant that is uniquely engineered to resist biodegradation for longer – this is quite unusual (in fact we believe it is unique) for a penetrant surfactant. The penetrant blend also contains a superwetting surfactant giving the whole formulation a very low surface tension and the ability of the product to disperse rain and dew from the sward (for a period after application) giving a drier leaf on average.

During very hot conditions:

During a heatwave – or prolonged hot conditions with daytime temperatures of 26^{o}C and above for > 10 days, we would recommend to increase the application rate for Formulation 42 to 17.5L/Ha or apply 12.5L/Ha every 3 weeks. In reality this would mean if an application had been made at 12.5L/Ha ahead of very hot weather then the next application should be bought forward to 3 weeks later and if then conditions were expected to continue then to up the rate to 17.5L/Ha monthly or remain at 12.5L/Ha and be prepared to re-apply again 3 weeks later.

Fairway use:

Formulation 42 can also be used on fairways and tees. Typical use rates are 10-25 litres per hectare applied every 30 to 90 days although some noticeable effects can be gained at 5L/Ha. Fairways will often show a significant difference most years when a block copolymer wetting agent is used at sufficient rate (low rates of application such as 2.5L/Ha/month can be suggested but these will have much reduced effects). The wetting agent allows greater uptake of moisture into the rootzone which then supports biological processes. During drought conditions grass cover can be lost and need extensive re-seeding where often a well-timed wetting agent (even in the absence of fairway irrigation) would have allowed a fast recovery and preserved the sward. Bear in mind that once soil has become very dry it becomes naturally hydrophobic and without a wetting agent it can be very difficult to re-wet in the short term.



Using Aquazone on our greens has really helped our moisture management programme, particularly during periods of high heat and ET. GBR provide us with in depth technical information which is delivered in an honest and open way which is something I really like. I've been able to work with GBR to create a bespoke turf hardening mix which has worked really well on our site.

Michael Mann

Course Manager,

Walton Heath Golf Club

Wetting Agent Range

HYDROZONE

Hydrozone™ is a 100% active (no diluents as supplied) non-ionic wetting agent developed for use on sports turf to prevent localised dry patch (LDP) and give additional benefits in relation to the use and action of water.

Hydrozone has been carefully engineered for maximum performance giving long residence time and a highly effective wetting action.

LDP can arise from hydrophobic soil conditions which may in turn arise from plant breakdown material, animal sources, fungi and critically low soil moisture content. Hydrophobic soils can inhibit even distribution of water in the soil profile, denying grass roots an adequate supply of water, water soluble nutrients and applied treatments.

Mode of Action

Hydrozone works by lowering the interfacial tension between water and other substrates (specifically soil constituents and grass roots) – this enables contact angles to be reduced and water to spread out laterally through the soil profile and flow into areas that were previously water repellent.

Benefits and Features

- Treatment and preventative for localised dry patch
- Contains a special surfactant to aid the initial spread into the rootzone
- Non-phytotoxic at use concentrations
- Non-scorch formula
- Excellent tank mix compatibility
- Potential to reduce water consumption where no turf wetter is currently used
- Assists in maximising the effectiveness of a range of soil chemicals and fertilisers

Please see the wetting agent introductory information for a fuller list of benefits of wetting agents.

Properties:

Appearance	Clear viscous liquid at room temperature
Solidification point	Below minus 15°C
Viscosity	600cP at 20°C
Maximum solubility	5-8% over typical temperature range
Surface tension	25 dynes/cm (3.5% solution in water)

Application

Hydrozone must be diluted in water prior to spray application. Hydrozone should be added to water rather than water added to Hydrozone – this avoids the potential for gel phases to form.

Hydrozone has widespread tank mix compatibility, however a jar test should be conducted first.
Speak to your technical sales contact for any advice.

Monthly application – March/April until September/October:

Zone	Hydrozone	Water Volume	Area	Notes
Greens/Tees/ Sports Pitches	20 litres (preferred) 10-20 litres under conditions of low drought stress	300-600 litres	1 hectare	Do not exceed solution strength of 5%. Water in within 24/48 hours and before cutting to avoid reduced performance.
Fairways	10-20 litres	300-600 litres	1 hectare	
Bowling Greens	1.5-3 litres	45-135 litres	1500m^2	

90 day application – start March/April, repeat 90 days later:

Zone	Hydrozone	Water Volume	Area	Notes
Greens/Tees/ Sports Pitches	50 litres	1000 litres	1 hectare	Do not exceed solution strength of 5%. Water in within 24/48 hours and before cutting to avoid reduced performance.
Fairways	25-50 litres	500-1000 litres	1 hectare	
Bowling Greens	7.5 litres	150 litres	1500m^2	

Pack sizes available

5 litre, 20 litre, 120 litre, 200 litre drums, 1000 litre IBC

Wetting Agent Range

AQUAZONE

Aquazone™ is a 100% active (no diluents as supplied) non-ionic wetting agent developed for use on sports turf to prevent localised dry patch (LDP) and give additional benefits in relation to the use and action of water.

Aquazone is a high quality product giving reliable performance at an exceptional price.

LDP can arise from hydrophobic soil conditions which may in turn arise from plant breakdown material, animal sources, fungi and critically low soil moisture content. Hydrophobic soils can inhibit even distribution of water in the soil profile, denying grass roots an adequate supply of water, water soluble nutrients and applied treatments.

Mode of Action

Aquazone works by lowering the interfacial tension between water and other substrates (specifically soil constituents and grass roots) – this enables contact angles to be reduced and water to spread out laterally through the soil profile and flow into areas that were previously water repellent.

Benefits and Features

- Treatment and preventative for localise dry patch
- Non-phytotoxic at use concentrations
- Non-scorch formula
- Excellent tank mix compatibility
- Potential to reduce water consumption where no turf wetter is currently used
- Assists in maximising the effectiveness of a range of soil chemicals and fertilisers

Please see the wetting agent introductory information for a fuller list of benefits of wetting agents.

Properties:

Appearance	Clear viscous liquid (hazy at low temp)
Solidification point	Below minus 10°C
Viscosity	500cP at 20°C
Surface tension	36 dynes/cm (3.5% solution in water)
Maximum solubility	12-15% over typical temperature range
Foam	Low
Biodegradability (OECD 901B test)	Readily

Application

Aquazone must be diluted in water prior to spray application. Aquazone should be added to water rather than water added to Aquazone – this avoids potential for gel phases to form.

Aquazone has widespread tank mix compatibility, however a jar test should be conducted first. Speak to your technical sales contact for any advice.

Monthly application – March/April until September/October:

Zone	Aquazone	Water Volume	Area	Notes
Greens/Tees/ Sports Pitches	20 litres (preferred) 15-20 litres under conditions of low drought stress	300-600 litres	1 hectare	Do not exceed a solution strength of 12% in water. Water in within 24/48 hours and before cutting to avoid reduced performance
Fairways	15-20 litres	300-600 litres	1 hectare	
Bowling Greens	3 litres	45-90 litres	1500m^2	

90 day application – start March/April, repeat 90 days later:

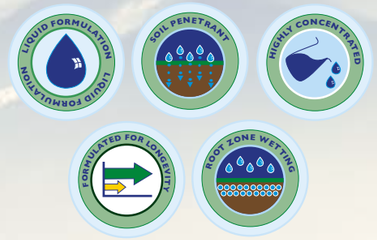
Zone	Aquazone	Water Volume	Area	Notes
Greens/Tees/ Sports Pitches	50 litres (preferred)	450-900 litres	1 hectare	Do not exceed a solution strength of 12% in water. Water in within 24/48 hours and before cutting to avoid reduced performance
Fairways	25-50 litres	210-900 litres	1 hectare	
Bowling Greens	7.5 litres	45-135 litres	1500m^2	

Pack sizes available

5 litre, 20 litre, 120 litre, 200 litre drums, 1000 litre IBC

PenetraX

PenetraX is a unique new penetrant wetting agent that is engineered to last longer, performing its function for a greater period of time after application. After application to rootzones, wetting agents will deplete over time through water washout and biodegradation. For a penetrant surfactant, the ability to partition into rain water to lower its surface tension and increase its removal is an important function so the washout potential needs to be maintained. However penetrant surfactants will rapidly biodegrade once in the soil and this can be undesirable. Bioaccumulation of the wetting agent is also undesirable. PenetraX will resist biodegradation for longer (whilst still ultimately biodegrading) and thus remain in the rootzone performing its function for longer.



As well as for summer use, penetrant wetting agents can bring benefits to sports turf over the autumn and winter helping the flow of water through the profile and dispersing surface water. Saturated surfaces can reduce the flow of air in the profile underneath and lead to anaerobic conditions – penetrant wetting agents can play a role in alleviating this under certain conditions.

Benefits and Features

- Concentrated formulation
- Excellent wetting performance
- Aids water infiltration
- Can reduce localised water logging
- Helps create a more even playing surface
- Supports the maintenance of aerobic conditions over autumn and winter

Pack sizes available

5 litre, 20 litre, 200 litre drums

Zone	PenetraX	Water Volume	Area	Notes
Greens/Tees/ Sports Pitches	4-5 litres	400-600 litres	1 hectare	Water in within 24/48 hours and before cutting to avoid reduced performance.
Fairways	4-5 litres	400-600 litres	1 hectare	
Bowling Greens	600-750 ml	60-90 litres	1500m^2	

Eco-Wet Penetrant

Eco-Wet Penetrant is a highly effective penetrant surfactant that is based on environmentally sustainable materials. Both the hydrophobic and hydrophilic portions of the surfactants used are derived from sustainable plants sources. This penetrant does not compromise its performance in favour of its environmental credentials and recommended use rates function as well as penetrant surfactants based on non-renewable raw materials. The hydrophobic group in Eco-Wet is a **palm oil** derived fatty acid, whilst the hydrophilic groups are derived from sugars.

Palm Oil

Palm Oil is considered the most sustainable fatty acid vegetable oil crop having by far the highest yield per hectare. Around 87% of global palm oil comes from Malaysia and Indonesia. The industry employs around 1 million people and there are a further 3 million small holdings world-wide – in short many millions of households depend upon palm oil. Eco-Wet surfactants come from a member of the Round-table for Sustainable Palm Oil (RSPO).

Benefits and Features

- Strongly aids infiltration of water through upper hydrophobic layers
- May reduce localised water-logging
- Helps create a more even playing surface
- Concentrated penetrant based on renewable plant chemistry
- Non-ionic in nature for excellent tank mix compatibility

Application

Must be diluted in water, as per the chart below, prior to spray application. May be used year round.

Pack sizes available

5 litre, 20 litre, 200 litre drums

Please see wetting agent introductory information for a fuller list of benefits of wetting agents

Zone	Eco-Wet	Water Volume	Area	Notes
Greens/Tees/ Sports Pitches	5 litres	300-900 litres	1 hectare	Water in within 24/48 hours.
Fairways	5 litres	300-900 litres	1 hectare	
Bowling Greens	750 ml	45-135 litres	1500m^2	

Wetting Agent Range

Influxer Residual Wetting Agent, Penetrant and Restorative

Influxer is a powerful penetrant wetting agent developed for use on amenity grass. Influxer provides effective wetting within the rootzone and can reduce water run-off. Influxer is highly effective at getting water through thatch layers and is good for restoring areas already affected by dry patch. Influxer achieves extremely low surface tensions in water and tests demonstrate an unusually high ability to spread water laterally on a surface. Influxer also has an inherent dew dispersant effect. Influxer also demonstrates a significant residence time and can be used as a residual wetter.

Due to its cost effective nature, Influxer is ideal for use on fairways but may be used on all areas.

Wetting agents help to maximise the availability of rain or irrigation water by ensuring water supply to the whole of the root zone and a more even distribution of water. Fairways without irrigation can still benefit from the use of Influxer by ensuring more even water penetration, reduced run-off from compacted and sloping areas and a quicker uptake of water into the soil following extended periods without rainfall.

Benefits and Features

- Cost effective for fairways
- Reduced water run-off
- Residual wetting ability
- Powerful penetrant properties
- Dew dispersal effect

Pack sizes available

5 litre, 20 litre, 120 litre, 200 litre drums

Please see the wetting agent introductory information for a fuller list of benefits of wetting agents.

Properties:

Appearance	Clear, low viscosity fluid
Solidification point	0°C
Surface tension	21 dynes/cm (0.2% aqueous solution)

Application

Apply monthly or less frequently as required but not exceeding 20 litres per hectare or applying more frequently than fortnightly.

Zone	Influxer	Water Volume	Area	Notes
Greens/Tees/ Sports Pitches	10-20 litres	300-900 litres	1 hectare	Water in within 24/48 hours and before cutting to avoid reduced performance
Fairways	10 litres	300-900 litres	1 hectare	
Bowling Greens	1.5-3 litres	45-135 litres	1500m^2	

Wetting Agent Range

Intensive Wetter Penetrant, Targeted Fairway Wetter and Curative

Intensive Wetter is a powerful surfactant that aids water infiltration. The particular strength of Intensive Wetter is its exceptional ability as a penetrant and the detergency of the surfactant when used appropriately. Intensive Wetter can be used selectively as a curative to emulsify hydrophobic materials which can then be removed from the rootzone with a strong water flush following application.

Intensive Wetter can be used year round to ensure the best penetration of water into the soil profile, assisting in the uptake of water from the surface. Intensive Wetter can be used cost effectively on non-irrigated fairways by application ahead of pending rainfall.

Intensive Wetter can also be used to 'wash' sand off hydrophobic material. Washing requires that the surfactant is allowed to act for a period of time on the area required – this will begin to emulsify hydrophobic material. However sufficient mechanical action is then required in the form of a strong water flush to complete the process and remove some of the emulsified hydrophobic material. When using as a curative it is best to discuss with a member of GBR Technology technical staff.

Benefits and Features

- Highly concentrated penetrant product means low use rates, cost effectiveness, less packaging and storage space and transportation costs
- Penetrant and curative effect from one product
- Strongly aids infiltration of water
- May reduce localised water-logging
- Curative action for localised treatment
- Helps create a more even playing surface

Pack sizes available

5 litre, 20 litre, 120 litre, 200 litre drums

Please see the wetting agent introductory information for a fuller list of benefits of wetting agents.

Properties:

Appearance	Clear, low viscosity fluid
Solidification point	<0°C
Surface tension	25 dynes/cm (0.5% aqueous solution)

Application

Zone	Intensive Wetter	Water Volume	Area	Notes
Greens/Tees/ Sports Pitches	1-3 litres	300-900 litres	1 hectare	Water in within 24/48 hours.
Fairways	1-3 litres	300-900 litres	1 hectare	
Bowling Greens	150-450 ml	45-135 litres	1500m^2	

AQUAZONE Irrigation Tank Tablet

A 3kg large tablet for addition to irrigation tanks. The tablets will dissolve slowly and uniformly, reducing the surface tension of applied water.

Aquazone Tablets are supplied with a mesh bag which can be used to hang the tablets near to inlet or outlet pipes. Putting tablets closer to the water flow will result in quicker dissolution and more effective surface tension reduction. Tablets can be placed further from any water flow if slower dissolution is required.

Aquazone Tablets in irrigation tanks will typically only achieve very low concentrations in solution due to the high volume of water present. However, even solutions with concentrations below 0.001% surfactant can achieve a significant reduction in surface tension compared with untreated water.

Benefits and Features

- Increases the wetting power of irrigation water
- Tablets dissolve uniformly and do not break-up or disintegrate
- 100% surfactant tablet - no binders or diluents
- Mild system cleaning effect

Application

The tablet should be removed from the plastic pail. Tablet can be placed in the supplied mesh bag and hung in the irrigation tank (such that the mesh bag can be retrieved at a future date) or may be dropped loose to the bottom of the tank.

Hanging tablets by inlet or outlet pipes will increase the rate of dissolution due to the increased water flow over the tablet. For larger tanks and bigger irrigation volumes it will become more necessary to increase the dissolution rate and/or number of tablets employed.

Pack sizes available

3kg tablets supplied in 3 litre white plastic pails with mesh sack.

Store upright in a cool dry environment (tablets will melt at 40-50°C but will re-form on cooling).

AQUAZONE Pellets

A unique 100% active, block copolymer wetting agent pellet with very low scorch potential, for use in hose-end applicators.

Aquazone Pellets will give effective wetting performance on 'hot spot' areas.

The pellets maintain their integrity and dissolve uniformly.

Benefits and Features

- Effective wetting performance
- Very low scorch potential
- Pellets dissolve uniformly and do not break-up or disintegrate
- 100% surfactant formulation with no use of binders or diluents

Application

Aquazone Pellets dissolve slowly as water passes over them reducing surface tension of applied water and thus increasing its wetting power.

Pellets should be removed from the pot before use and placed into the hose end applicator. Water greens, tees and hot spots as required.

One tablet will treat up to 6-7 greens.

Pack sizes available

Sold in boxes of 6 x 250g pellets.

Approximate pellet dimensions – 55mm (diameter) x 80mm (height).

Storage

Store upright in a cool dry environment

Aquazone Pellets melt at 40-50°C and should be stored below this temperature. Above this temperature pellets may melt but will readily re-form on cooling without any loss of performance.

Tips and Tricks on Spray Tank Mixing

Tips and Tricks on Spray Tank Mixing

Tank mix compatibility is a significant topic of interest to Greenkeepers and Groundsman. The ability to mix and spray out a variety of products means you can apply a range of NPK and other nutrients as well as other turf treatments.

So what do we mean by tank mix compatibility? The most obvious answer is to ensure that what you're mixing remains soluble and does not generate any precipitates – this would block nozzles and necessitate a tank clean out.

One of the most frequently generated precipitates is calcium sulphate – this is a white sparingly soluble material – by sparingly soluble we mean not too soluble at all!

So mix for example ammonium sulphate and calcium nitrate and you'll form a thick white precipitate of calcium sulphate – whoops! When you dissolve soluble ionic salts into water they will ionise and the ions will be dispersed in the water. In our example you'll have 4 ions – ammonium, calcium, nitrate and sulphate – the first two are cations (they carry a positive charge) and the latter two anions (they carry a negative charge) – if any combination of cation and anion can combine to form an insoluble salt – guess what – they will do! In this case the calcium finds the sulphate and they combine to form a precipitate which falls out of solution.

The good news is that all nitrates and all chlorides are soluble. But beware some phosphates, phosphites and some sulphates aren't! Many carbonates or hydroxides are also insoluble.

The above focus was on mixing straights.

Chelates however can offer tank mix advantages and many chelated products will offer much better tank mix capability. You can even add a pure chelating agent to your tank so you can mix things you couldn't normally mix but make sure you do it in the right order – if the precipitate has already formed it's too late (although some very powerful chelates can put things back into solution – but don't rely on that!).

Mixing of ferrous sulphate and potassium ammonium phosphite produces a heavy precipitate of iron phosphites

In this case the potassium ammonium phosphite has been mixed with Forti-Fe – a fully formulated ferrous sulphate rich blend with additional chelating agents – the mix is clear and suitable for spraying

So back to our calcium nitrate and ammonium sulphate example – if you fully dissolve the calcium nitrate then add sufficient citric acid – stir it in well – this will 'chelate' the calcium ions – by that we mean they will bind around them – you can then add the ammonium sulphate and you won't get a precipitate – at least for a while! This must be done right of course – get the order of addition wrong, put insufficient chelator in or don't spray out quickly enough (in this example the citric acid might only give about 30-60 minutes protection until a pecipitate starts to form) and you're in trouble – best to speak to us first and ensure all your staff are well trained on the mix.

So on to jar testing – in short it's a really good idea to do if you are trying a new mix. Just turn litres into millilitres and kg into grams in going from the real world spray tank to your test jar. Let's give an example. Say you want to spray 20kg ferrous sulphate and 10 litres potassium ammonium phosphite in 400 litres water. That means add 400 millilitres of water to your jar, dissolve 20 grams of ferrous sulphate and then 10 millilitres of phosphite and you have your ratio (in this case you will get a precipitate so you'll know it's not a suitable mix – try again replacing the ferrous sulphate with Forti-Fe – which contains citric acid along with ferrous sulphate and there's no precipitate)! Use the water source that you will be using and leave the jar to stand for a few hours (the spray duration). It's fairly straightforward but you may need to buy a relatively inexpensive scale and a few measuring cylinders! Best always to stick to the same order of addition although in most cases it will make no difference – in some it might though!

Moving on from straights to formulated products – the same applies – bear in mind that Companies can sometimes change their formulations slightly. And of course with natural products – you will get a natural variation – unlikely to make the difference between a mix being stable or not most of the time – but it is possible – especially if the product is past its expiry date.

STRI Test

Summary of STRI findings on the performance of Aquazone™ and Hydrozone™ against an untreated control and a global market leading product.

From April till October, a wetting agent test programme was performed by the STRI. Candidates under test were Hydrozone, Aquazone and a global market leading product - alongside an untreated control reference. In line with protocol, multiple plots were used for each product/control reference to ensure that only statistically valid results formed the basis of any conclusions.

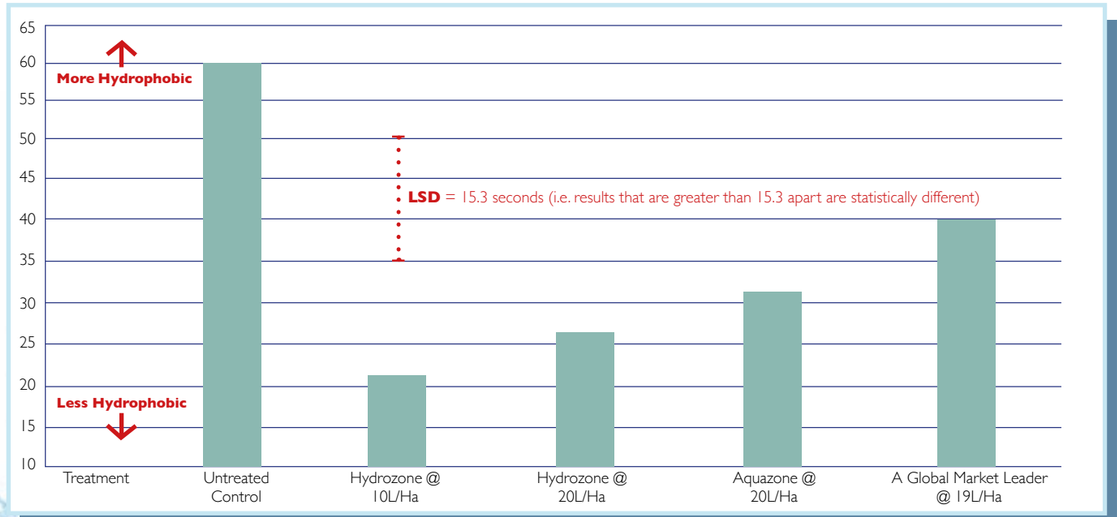
The test site was an area of golf green turf grown on a sandy loam root zone at the STRI experimental ground in Bingley, Yorkshire. The turf used for the trial had suffered from dry patch issues in the past. The trial included two periods of 'dry down' – withholding irrigation and using covers, when required, to keep off rain water.

Six parameters were used for the assessments; turf quality, visual turf colour, normalised difference vegetation index by hand-held NDVI meter, dry patch incidence and volumetric moisture content which were all tested regularly throughout the trial and actual soil water repellency (WDPT) which was measured at the end of the trial.

The conclusions showed significant benefits to using Hydrozone and Aquazone over the untreated control.

- Hydrozone and Aquazone significantly reduced the incidence of dry patch formation when the turf was put under moisture stress
- Average soil moisture contents remained higher under moisture stress when using Hydrozone and Aquazone but were not affected at normal moisture contents
- Hydrozone and Aquazone speeded up the re-wetting of the soil profile after a dry down period
- Hydrozone and Aquazone significantly reduced the hydrophobicity of the soil
- A global market leading product tested as part of the trial showed the same benefits listed above but did NOT outperform Hydrozone and Aquazone on the tests undertaken
- Hydrophobicity was tested by measuring the water droplet penetration time and a Hydrozone application within our recommended rates came out as superior and the optimal treatment from the trial.

Water Droplet Penetration Time (in most hydrophobic zone)



... our
Dew Dispersant Range

Influxer Excel Dew Dispersant and Wetting Agent

Influxer Excel is essentially a more concentrated version of Influxer. Apply at 1-2.5 litres per hectare

Application

Apply monthly or less frequently as required but not exceeding 3 litres per hectare or applying more frequently than fortnightly.

Pack sizes available

1 litre, 5 litre

Zone	Influxer Excel	Water Volume	Area	Notes
Greens/Tees/ Sports Pitches	1-2.5 litres For maximum dew dispersancy use 2 litres	200-900 litres	1 hectare	Do not exceed a solution strength of 1% When using as a wetting agent, water in within 24/48 hours and before cutting to avoid reduced performance
Fairways (golf)	1 litre	200-900 litres	1 hectare	
Bowling Greens	150-375 ml	22-135 litres	1500m^2	

Endew Plus Advanced Formulation Dew Dispersant

Endew Plus is a highly optimised and long lasting dew dispersant that gives an extended effect. Rapid removal of rain, dew and guttation fluid leads to drier sward which can significantly reduce the potential for fungal turf diseases as well as aid playability of putting surfaces.

Maximum longevity is achieved during periods of reduced plant growth and cutting, however trials in late August still showed a degree of dew dispersancy after 10 days and 8 cuts. Longevity during optimum periods should be in the range of 2-3 weeks.

Discussion

Switching has long been promoted as good cultural practice to keep the sward drier and help reduce incidence of fusarium patch, however switching will only remove dew and guttation fluid at the time it is done and not stop it building back up. A dew dispersant can stop the build-up of rain, dew and guttation fluid day and night for extended periods. Trials of a new breed of highly effective dew dispersants have shown dramatic effects on reducing incidence of fusarium patch.

Benefits and Features

- High performance products
- Aids morning playability on putting surfaces
- Drier sward reduces susceptibility to fungal diseases
- Also provides a penetrant wetting effect within the rootzone

Application

For most reliable results apply as a standalone spray onto dry turf. Dissolve 5 litres of Endew Plus in 300-450 litres water and spray apply to 1 hectare of greens. Can be used mid-August until end of spring, applied up to every 10-21 days. Do not apply immediately ahead of heavy rain.

Pack sizes available

5 litre

Zone	Endew Plus	Water Volume	Area	Frequency
Greens/ Tees/Sports Pitches	5 litres	300-450 litres	1 hectare	Every 10 to 21 days as required. Do not apply more then twice monthly.
Bowling Greens	750 ml	45-68 litres	1500m^2	

Reformulated for 2022

Dewel Dew Dispersant and Winter Wetting Agent

Dewel is a dew dispersant with dual action – additionally functioning as a winter wetting agent. Dewel is 100% active with no diluents or carrier solvents and oils. Instead of bulking the formulation with carriers, additional long lasting surfactants are used – these will 'dose' the rootzone ahead of the growing season and will have the added benefit of preparing the soil in the event of early season dry conditions.

Mode of Action

Silicone based superwetting surfactants in Dewel will coat the leaf surface. The nature of these particular surfactants prevents water from beading up on the surface and so prevents the formation of dew. The additional surfactant present will reside in the rootzone and give a long lasting wetting effect to assist in overcoming any hydrophobic conditions that may arise over winter.

Benefits and Features

- Allows a dew-free playing surface without the need for switching
- Long lasting effect: 1-2 weeks
- Reduces potential for diseases arising from damp sward conditions
- Non 'suffocating' formulation can be used regularly without adverse effect
- Dewel has a dual effect – dew dispersing and winter wetting agent
- Prepares rootzone wetting ahead of the growing season

Application

Apply as required at 6 litres per hectare but not more often than weekly. Dewel must be diluted in water prior to application.

Pack sizes available

1 litre, 5 litre, 20 litre

Zone	Dewel	Water Volume	Area	Notes
Greens/Tees/Sports Pitches	6 litres	300-400 litres	1 hectare	Ensure sufficient mixing before spraying
Bowling Greens	900ml	45-60 litres	1500m^2	

Important note: Dewel needs thorough mixing in water. The formulation is engineered not to be so readily soluble – this assists with field longevity. Ensure tank recirculation for at least 10 minutes and check to see that material is fully dissolved before spraying.

I used Aquazone Wetting Agent Pellets this year as I have had dry patch but do not spray a monthly wetting agent through the summer. The difference between hand watering with and without a pellet is massive. I intend to continue hand watering with Aquazone Pellets. Also, GBR's spreadable iron with 12% Fe gives a really nice green-up and hardening-off against disease – the product is easy to use and has uniform granule size.

Gary Kennington

Head Greenkeeper

St. Augustines Golf Club

Effective Dew Dispersancy

The New Programme for Fungal Disease Control?

The use of switching has long been promoted as best practise to aid the reduction of fungal disease, as well of course for early morning playability. Switching though will not prevent dew and rain building up on the sward – it is only used at regular intervals to knock the moisture off. With a highly effective dew dispersant you can keep surfaces much drier night and day – aiding playability but also crucially reducing the likelihood of fungal disease outbreak.

We have seen some dramatic results now from an effective dew dispersant programme. Key is to use a product that it both highly effective and long lasting as well as not depositing an appreciable film on the leaf surface (which can affect the effectiveness of fungicidal sprays). Enter two products from GBR Technology – one brand new and one redirected from its initial use as a wetting agent.

Endew Plus – an anionic-type dew dispersant for use at 5 litres per hectare.

Programme: Apply every 2 weeks during autumn and winter at 5 litres per hectare (i.e. 10L/Ha consumption per month)

Influxer Excel – a siliconised surfactant type dew dispersant for use at 2 litres per hectare.

Programme: Apply every 2 weeks during autumn and winter at 2 litres per hectare (i.e. 4L/Ha consumption per month)

Notes: Influxer Excel has wider tank mix compatibility but should not be acidified below pH 5.
It is best to apply an Influxer Excel solution onto dry sward.

Both the above applications give very reliable dew dispersancy under suitable conditions and for extended periods. High growth rates and cutting will of course reduce the effect quicker.

Two highly effective dew dispersants with disease suppressing qualities. GBR's NEW Endew Plus and Influxer Excel tailored for use at 2L/Ha for dew dispersal.

An outbreak of fusarium in February 2019. Influxer Excel was used at 2L/Ha however the spray solution ran out on the final green with result that a third of the green was left untreated. The fusarium outbreak was only seen on the untreated portion of the green and was not present elsewhere on the green or anywhere else on the course where an Influxer Excel programme had been applied

... our
Fertiliser Range

Fertiliser Range

Introduction

Let's consider the sixteen elements that are essential for the growth of the grass plant.

Carbon, hydrogen and oxygen – these elements make up 90% - 96% of the grass plant in dry matter terms. It should be noted these are for free and are dependent upon sound cultural practice being implemented to ensure adequate levels of photosynthesis, respiration and osmosis are taking place thereby allowing the production of organic molecules essential for the development of the grass plant.

This leaves us with thirteen elements making up the other 4% - 10% and these elements are grouped into ***Macro and Micro Nutrients:***

Macro Nutrients *– nitrogen, potassium, phosphorus, sulphur, magnesium and calcium*

Micro Nutrients *– boron, chlorine, copper, iron, manganese, molybdenum and zinc.*

Factors influencing the availability of nutrients to the plant from the soil are:

- Microbial activity
- Cation exchange capacity arising from the clay/humus complex
- The buffering capacity of the soil to replace nutrients used up by the plant and lost through leaching and volatilisation
- The balance of air and moisture within the soil and how this is influenced by rainfall, soil structure and drainage rates throughout the year
- Soil temperature
- Soil pH
- Average depth of root mass and an understanding of how this section of the profile performs throughout the year.
- Maintaining aerobic soil conditions at all times

Soil Analysis

This includes an assessment of both the availability of nutrients and the proportions of sand, silt, clay and organic matter present. There are a number of different analyses that can be carried out, however, exactly what should be assessed is best left to the Course Manager and the Club's Agronomist who, between them, will have a good understanding of the main play areas, how these areas perform over the year and any issues that need attention.

There is also the availability of leaf tissue analysis and this can be called upon as and when such a need is determined. GBR Technology offer soil and leaf tissue analysis services.

A Fertiliser Programme

This has to be driven primarily by the needs of the grass plants that make up the sward whether it be for a green, tee, apron or fairway and this judgement rests with the Course Manager and the Club Agronomist.

Factors that are likely to be considered are:

- The range of factors already mentioned above
- The demands placed upon the sward by play and extremes of weather
- The quality of surface required
- The grass species being developed and managed
- The time of year
- Disease pressure
- Surface speed
- Regrowth rate
- Volume of grass being boxed off or allowed to fly
- Colour
- Density
- Uniformity
- Height of cut
- Root development
- Availability of manpower and machinery to implement all necessary tasks
- Granular or liquids
- Programme of fixtures and timing of fertiliser response
- Responding to the weather cycle and the challenges that arise from the changing environmental conditions
- Budgetary restrictions

There are no doubt other factors that have to be taken into consideration. However, the main points already mentioned clearly highlight that the closer a programme can be in tune with the natural cycle and be implemented in a responsive and effective manner then the best opportunity arises to deliver the standards being aimed for with minimum disruption to player.

Although all nutrients mentioned earlier under headings Macro and Micro it is the N, P and K that generally make up the content of most feeds with nitrogen being the dominant element during the spring/summer period. How much nitrogen and frequency of its application will vary from course to course but there should be an understanding of how much N the selected sward will need for the year to deliver the plant health required. The timing of application and the amount supplied should be such that the plant maintains a natural colour and delivers a growth rate that avoids lushness and excess of clippings and when all influencing factors are considered then the responsibility for this judgement throughout the year has to rest with the Course Manager. To assist the Course Manager make the right judgement, GBR highlights the total N available within a fertiliser along with the source of the nitrogen thereby allowing the Course Manager to gauge the likely turf response bearing in mind the prevailing environmental and soil conditions at the time of application.

Over time, it is good practice to keep a record of the fertiliser applied, environmental conditions and the turf response. As this data builds up then the optimum quantity of nitrogen in g/m^2 per treatment to deliver plant health and density without excess growth will be gained and this knowledge will produce savings over time.

GBR's Range of Fertilisers

Our fertiliser range includes the following types:

- Straights and compound
- Blended
- Homogeneous crumb
- Liquid
- Soluble prills, crystals and powders
- Inorganic and organic
- Slow and controlled released technologies

Straights

A straight fertiliser is one that contains only one plant nutrient whereas a compound will contain two or more plant elements and these are made by chemically or physically combining two or more straight fertilisers.

Blended

These types of fertiliser will supply one or more nutrients to the plant using different sources and are ideal for delivering a wide range of grades. The sources for the blend can be single straights, compounds,

organic, inorganic or controlled/ slow release prills. To get best effect then the individual particles of the blended materials should be similar in size otherwise a greater degree of segregation will occur thus affecting uniformity of application and nutrient delivery to the sward.

Homogeneous Crumb

This is a granulated product whereby each individual crumb contains the elements in the proportions highlighted on the label e.g. 12-6-6. These products can be produced in mini granules and in some cases micro granules with the latter allowing lower application rate/m^2 without loss of uniformity of cover or delivery of nutrients to the sward.

Liquids

These products allow accurate application of nutrients to the grass plant some of which will be absorbed by the leaf. A wide range of grades can be produced from a single nutrient spray of N to a compound application of N-P-K+TE. Trace elements and stimulants like humates and seaweed can also be applied in this manner and the end user has the option of creating his own blend using compatible products.

Soluble Prills, Crystals and Powders

Purchasing good quality technical grade soluble products is a cost effective way of applying nutrients especially nitrogen e.g. 25kg of soluble urea will deliver 1.15g of N/m^2 over 1Ha at the current cost of about £16. Having access to a good, reliable sprayer is essential should a spoon feeding approach be adopted. Like liquids, the application of soluble materials gives the user the opportunity to be very accurate with application rates and thereby gain greater control over nitrogen input and subsequent growth rates.

Inorganic and Organic

Inorganic fertilisers are sourced from naturally occurring minerals that are mined or are produced synthetically. These types of fertiliser are generally more concentrated, faster acting and will have varying salt index readings that in turn highlight the potential to scorch. Organic fertilisers, on the other hand, are derived from organic sources such as plant and animal residues, animal manure and contain plant nutrients in organic form. These organic materials have to be broken down by the soil food web before the nutrients become available to the plant and for some, this allows not only the feeding of the plant, but the feeding of the soil and the organisms that are essential for long term stability of the edaphic environment.

Slow and Controlled Release Fertilisers

Examples of slow and controlled release would include IBDU, methylene urea, polymer coated urea, sulphur coated urea and urea based fertilisers containing urease and nitrification inhibitors. Factors that affect the availability of nitrogen from urea include solubility of the urea source, the size of the prill, coating thickness, soil temperature, microbial activity and available moisture. These factors can and do influence the release of nitrogen and longevity of supply so although considered to be slow/controlled there will be times when environmental conditions increase the rate of availability leading to stronger or lush growth. Although mainly used for the supply of nitrogen, other elements can be delivered through the slow/controlled release process and these are linked to the coated products that are available today.

Please note in the following pages, nitrogen sources denoted as follows:

A.N. = Ammoniacal Nitrogen N.N. = Nitrate Nitrogen
U.N. = Ureic Nitrogen O.N. = Organic Nitrogen

Nitrogen

Nitrogen is a vital input to turf grass management playing a key role in influencing turf quality and health. Nitrogen is present in all amino acids which are the building blocks of proteins (which make up living tissue) and is also present in chlorophyll.

Nitrogen is present in the earth's atmosphere being the main constituent of air (nitrogen concentration in air is 79%). However, the 'fixation' of nitrogen into available forms is not so readily achieved.

Fixation can be done commercially in the production of nitrogen containing synthetic fertilisers. In nature certain plants, for example clover, can 'fix' nitrogen directly into the soil from air. In the atmosphere processes such as lightning can produce oxides of nitrogen which dissolve in rain to form very dilute nitrous and nitric acid which can add nitrogen to soils – similarly pollution can add additional nitrogen.

Simplistically we can consider nitrogen in two forms – organic and inorganic. Organic forms first need to be broken down by a process called 'mineralisation' – this generates inorganic nitrogen which can be readily taken up by the grass plant.

Inorganic nitrogen includes urea, ammonia gas, ammonium compounds, nitrites and nitrates.

Nitrogen in ammonium form and nitrate form are readily taken up by turf. Ammonia itself is a pungent gas and is toxic to grass but it is highly soluble and once in solution will readily convert to ammonium form.

Nitrogen fertilisation:

Nitrogen is typically supplied in the form of urea, ammonium ions and nitrate ions in commercial fertilisers - let us consider these forms:

Urea – is a very high nitrogen fertiliser source containing 46% N by weight. Once in the soil urea is rapidly broken down by the enzyme urease to produce ammonia gas and carbon dioxide. The process requires moisture and is temperature dependent – occurring typically (from straight urea) in 1 to 7 days depending upon temperature. The ammonia from the breakdown can be prone to volatilisation (ammonia is a gas) however watering-in will ensure more of the ammonia produced dissolves on contact to produce ammonium ions which remain in the profile and support turf health. Products exist to slow the breakdown of urea using urease inhibitors and so give a slower and steadier release of ammonium ions.

Ammonium – is regarded as the best form of nitrogen for turf grass – it is readily utilised but, unlike nitrate, turf grass seems more able to regulate use of ammonium to more closely match its needs. Ammonium is actually an ion carrying a positive charge (cationic). Being positively charged it is able to better bind to the soil via its cation exchange capacity (CEC) and is much less prone to leaching and run-off than nitrate.

Ammonium ions will however themselves undergo enzyme catalysed reactions. Nitrosomonas will convert ammonia to nitrite and nitrobacter will convert nitrite on to nitrate. In some respects this onward conversion is undesirable and products exist to inhibit this conversion thus keeping more of the nitrogen in ammonium form.

Nitrate – is a very readily available source of nitrogen for turf-grass and will generally result in a fast flush of growth. Useful at times and for cool season fertilisation. Turf grass is less able to regulate the uptake compared with ammonium however. Nitrate is also an ion and in this case carries a negative charge (anionic) – it is not well bound by the CEC of the soil and is readily leached – leading to nitrogen loss and contamination in water courses and lakes.

As well as the inorganic forms (some of which were discussed above) nitrogen may also be provided in organic forms in commercial fertilisers. These may be derived from a range of sources for example chicken litter, feather meal, insect meal and seaweed (and quite a few other sources). Nitrogen will be present in a range of chemical compounds for example proteins, amino acids and amines which will breakdown in the soil to form ammonia and ammonium ions (which can also further convert as discussed above, to nitrite and nitrate).

Granular Homogeneous Fertilisers

Our flagship range of premium grade fertilisers, V-Pro granular NPK grades are homogeneous, meaning that each granule contains an array of nutrients and helps ensure an even nutrient distribution. Even distribution can be further enhanced by the use of micro granules (0.5-1.5mm) and well as traditional mini granule (1-2.5mm).

The range below summarises some popular grades but a wider range is available – please ask if you have a specific requirement.

Please note for nitrogen source:

A.N. = Ammoniacal Nitrogen
U.N. = Ureic Nitrogen
N.N. = Nitrate Nitrogen
O.N. = Organic Nitrogen

Product Name	Analysis	Nitrogen Source	Treat Rate (g/m²)	Field Longevity (Weeks)	Season	Granule Size (mm)
V-Pro Spring Greens with seaweed - Mini	10-4-4 + 4MgO + 3Fe + 8%CaO + seaweed	A.N. = 6.8% N.N. = 2.3% U.N. = 0.9%	25-50	4-6	Spring	1.0-2.5
V-Pro Spring Greens with seaweed - Micro	10-4-4 + 4MgO + 3Fe + 8%CaO + seaweed	A.N. = 6.8% N.N. = 2.3% U.N. = 0.9%	25-50	4-6	Spring	0.5-1.5
V-Pro Summer Greens with seaweed - Mini	8-0-4 + 2MgO +8CaO + seaweed	A.N. = 8%	25-50	4-6	Summer	1.0-2.5
V-Pro Summer Greens with seaweed - Micro	8-0-4 + 2MgO +8CaO + seaweed	A.N.= 8%	25-50	4-6	Summer	0.5-1.5
V-Pro Autumn Greens with seaweed - Mini	3-0-22 + 4MgO + 3Fe + 6CaO + seaweed	A.N.= 0.75% U.N.= 2.25%	25-50	4-6	Autumn	1.0-2.5
V-Pro Autumn Greens with seaweed – Micro	3-0-22 + 4MgO + 3Fe + 6CaO + seaweed	A.N.= 0.75% U.N.= 2.25%	25-50	4-6	Autumn	0.5-1.5
V-Pro Spring and Summer Zero Phos 2MgO +2Fe - Mini	12-0-9 +2MgO +2Fe	A.N.= 12%	25-50	4-6	Spring/ Summer	1.0-2.5
V-Pro Spring and Summer - Mini	12-3-9 +2MgO + 2Fe	A.N.= 12%	25-50	4-6	Spring/ Summer	1.0-2.5
V-Pro 14-0-7 + 3MgO +2Fe - Mini	14-0-7 +3MgO +2Fe	A.N.= 12.62% U.N.= 1.38%	25-50	4-6	Spring/ Summer	1.0-2.5
V-Pro 4-0-8 + 4Fe - Mini	4-0-8 +4Fe	A.N.= 4%	25-50	4-6	Spring/ Summer	1.0-2.5

Micro granules allow lower use rates compared with mini granules and give a more even distribution of nutrients – in effect you have even better control of the distribution of your fertiliser. Micro-granules may also be less prone to pick up by mowers in the days following spreading.

Granular Blended Fertilisers

Greens Grade

GBR can supply bespoke greens grade/mini grade 100% fast release fertilisers with varying macro nutrient concentrations and differing trace elements for both summer and winter use. Listed below are some of our standard products.

Benefits and Features:

- Cost effective
- Bespoke grades offer exceptional flexibility to meet your requirements
- Fast nitrogen release
- Formulated for different season use

Product Name	+ Fe (%)	+ Mg (%)	Additional Information	Treat Rate (g/m^2)	Field Longevity (Weeks)	Season	Granule Size (mm)
11-5-5	–	–	–	35-50	4-6	Spring/Summer	1.5
8-0-0 (2%)	2	–	–	35-50	4-6	Spring/Summer	1.5
8-0-0 (4%)	4	–	–	35-50	4-6	Spring/Summer	1.5
14-0-7	2	2	Phosphate Free	35-50	4-6	Spring/Summer	1.5
12-3-9	1	0.5	–	35-50	4-6	Spring/Summer	1.5
12-0-9 (2%)	2	2	–	35-50	4-6	Spring/Summer	1.5
12-0-9 (1.5%)	1.5	0.5	Seaweed Enhanced	35-50	4-6	Spring/Summer	1.5
6-5-10	6	–	–	35-50	4-6	Autumn/Winter	1.5
7-0-14	4	–	–	35-50	4-6	Autumn/Winter	1.5
3-0-3	4	2	Turf Hardener	35-50	4-6	Autumn/Winter	1.5
3-0-0	3	–	Lawn Sand	35-50	4-6	Autumn/Winter	1.5
3-0-0	7	–	Lawn Sand	35-50	4-6	Autumn/Winter	1.5

Fairways

GBR supply the following 2.5mm-3.5 mm compound granular range of fertilisers. This range is suitable for use on all amenity turf above 10mm cutting height such as golf fairways, football pitches and cricket outfield. These use conventional fast acting nutrient sources that produce immediate results.

Product Name	Treat Rate (g/m^2)	Field Longevity (Weeks)	Season	Granule Size (mm)
9-3-7	35-50	4-6	Spring/Summer	2.5-3.5
9-7-7	35-50	4-6	Spring/Summer	2.5-3.5
12-6-6	35-50	4-6	Spring/Summer	2.5-3.5
12-3-6	35-50	4-6	Spring/Summer	2.5-3.5
3-6-12	35-50	4-6	Autumn/Winter	2.5-3.5
6-9-6 Pre-Seeding	35-50	4-6	Anytime	2.5-3.5

Granular - Controlled Release Fertilisers

Granular fertilisers have the advantage over liquids of applying a large amount of nutrient which should be available for a greater period of time (of course liquids have their advantages too). In many cases it is desirable to control or extend the nutrient release properties of granules still further. There are quite a wide range of technologies now available for achieving this and each technology will have its own advantages and disadvantages over the next one.

In summary polymer coatings can be used which will slow the rate of nutrient release (all nutrients) and for controlling or slowing nitrogen release specifically then various nitrogen sources (e.g. methylene urea) can be employed or inhibitors can be added which inhibit some of the enzyme catalysed reactions of nitrogen compounds in the soil.

In some of the technologies, conditions can arise a period of time after application which can lead to a rapid change in the nutrient release characteristics (for example changes in temperature and moisture levels and microbial activity).

GBR Technology offer a range of controlled release technologies.

Controlled Release – Methylene Urea

Methylene Urea (MU) acts as a controlled release nitrogen source allowing these fertilisers to have longevity of up to 12 weeks. The first release of nitrogen comes from the urea itself, followed slowly by the available water-soluble nitrogen and finally the water insoluble nitrogen. Each release mechanism slightly overlaps to ensure that release of nitrogen is completely controlled and consistent. Methylene Urea is released by hydrolysis and soil microbial activity meaning that it is not solely dependent on soil moisture or temperature for its ideal release pattern. Granule size does not have any effect on the release rate of nitrogen.

Product Name	+ Fe (%)	+ MgO (%)	MU	Additional Information	Treat Rate (g/m²)	Season	Granule Size (mm)
12-0-9	2	1	25%	Trace Elements	35-50	Spring/Summer	1-2 or 2-3
22-0-22	1		65%	Trace Elements	25	Spring/Summer	1-2
16-0-16	1		50%	0.3 Mn	25-35	Spring/Summer	1-2
5-0-10	6	2	25%		35-50	Autumn/Winter	1-2
7-0-14			50%		35-50	Autumn/Winter	1-2
40-0-0			100%			Spring/Summer	1-2

Other grades are available on request.

Controlled Release – Polymer Coated

GBR offer controlled release granular fertilisers that are polymer coated to give longevity of 3-4 months or 5-6 months depending upon the coating thickness. Coated granules provide consistent feeding for better turf quality. The coatings are not affected by drastic temperature changes or excessive rainfall and are suitable for turf which has varying pH balances. The percentage of coated granules is balanced to give suitable release patterns.

Greens Grade

3- 4 Month Longevity

Product Name	+ Fe (%)	+ Mg (%)	Nitrogen Source	% of Coated Granules	Season	Granule Size (mm)
V-Pro PolyG 25-4-10			U.N. = 25%	50	Spring/Summer	1.25
V-Pro PolyG 34-0-0			A.N. = 7.6% U.N. = 26.4%	70	Spring/Summer	1.25
V-Pro PolyG 20-0-20			A.N. = 7% U.N. = 13%	65	Spring/Summer	1.25
V-Pro PolyG 18-5-18	2		A.N. = 3.4% U.N. = 14.6%	50	Spring/Summer	1.25
V-Pro PolyG 14-2-5	2		A.N. = 10.5% U.N. = 3.5%	25	Spring/Summer	1.25
V-Pro PolyG 15-0-23	2	2	A.N. = 3% U.N. = 12%	75	Autumn/Winter	1.25
V-Pro PolyG 5-10-12	2		A.N. = 3.5% U.N. = 1.5%	30	Autumn/Winter	1.25

5-6 Month Longevity

Product Name	+ Fe (%)	Nitrogen Source	% of Coated Granules	Season	Granule Size (mm)
V-Pro PolyG 23-4-10		A.N. = 9.2% U.N. = 13.8%	60	Spring/Summer	1.25
V-Pro PolyG 38-0-0		A.N. = 4.6% U.N. = 33.4%	70	Spring/Summer	1.25
V-Pro PolyG 24-0-24		U.N. = 24%	70	Spring/Summer	1.25
V-Pro PolyG 18-4-18	2	A.N. = 3.5% U.N. = 14.5%	65	Spring/Summer	1.25
V-Pro PolyG 14-2-10	2	A.N. = 10.5% U.N. = 3.5%	25	Spring/Summer	1.25
V-Pro PolyG 18-0-30		A.N. = 1.2% U.N. = 16.8%	75	Autumn/Winter	1.25
V-Pro PolyG 8-8-10	2	A.N. = 5.6% U.N. = 2.4%	30	Autumn/Winter	1.25

Fairway/Sports Pitch/Outfield Grades – Cutting height greater than 10mm

3- 4 Month Longevity

Product Name	Nitrogen Source	% of Coated Granules	Season	Granule Size (mm)
V-Pro PolyF 25-5-5	A.N. = 11.3% U.N. = 13.7%	55	Spring/Summer	2.5-3
V-Pro PolyF 25-5-10	A.N. = 9.8% U.N. = 15.2%	50	Spring/Summer	2.5-3
V-Pro PolyF 12-6-6	A.N. = 8.3% U.N. = 3.7%	30	Spring/Summer	2.5-3
V-Pro PolyF 15-0-22	A.N. = 6% U.N. = 9%	60	Autumn/Winter	2.5-3
V-Pro PolyF 3-6-12	A.N. = 1.5% U.N. = 1.5%	50	Autumn/Winter	2.5-3

5-6 Month Longevity

Product Name	Nitrogen Source	% of Coated Granules	Season	Granule Size (mm)
V-Pro PolyF 23-4-10	A.N. = 9.2% U.N. = 13.8%	60	Spring/Summer	2.5-3
V-Pro PolyF 25-5-10	A.N. = 9.6% U.N. = 15.4%	50	Spring/Summer	2.5-3
V-Pro PolyF 38-0-0	U.N. = 38%	100	Spring/Summer	2.5-3
V-Pro PolyF 21-0-0	A.N. = 9.5% U.N. = 11.5%	55	Spring/Summer	2.5-3
V-Pro PolyF 20-0-29	U.N. = 20%	80	Autumn/Winter	2.5-3

Controlled Release: iNhibit

Stabilised nitrogen release products that inhibit the production of enzymes that results in rapid breakdown of urea and further nitrification to nitrite and nitrate. These grades thus give a controlled release and minimise nitrogen volatilisation and leaching.

Greens Grade

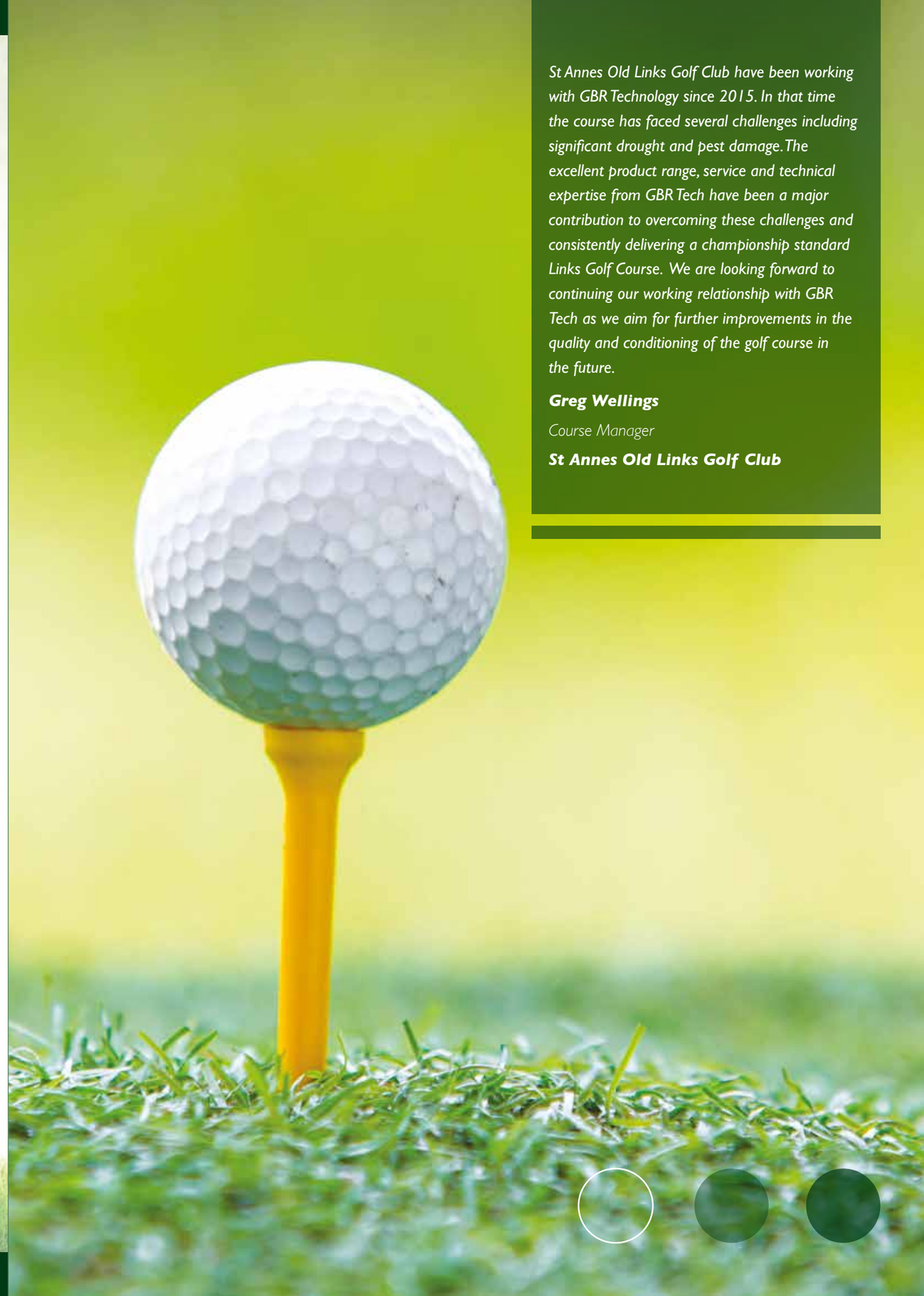
Product Name	Nitrogen Source	% of Granules Treated	Field Longevity (Weeks)	Season	Granule Size (mm)
iNhibit 25-5-12 +2Mg	U.N. 18.8% A.N. 6.2%	50	21-26	Spring/Summer	1-2
iNhibit 20-0-20 +2Mg	U.N. 14.9% A.N. 5.1%	50	21-26	Spring/Summer	1-2
iNhibit 14-2-7 +2Fe	U.N. 4.2% A.N. 9.8%	30	21-26	Spring/Summer	1-2
iNhibit 14-0-14 +2Mg	U.N. 7% A.N. 7%	50	21-26	Spring/Summer	1-2
iNhibit 15-5-20 +3Mg	U.N. 7.4% A.N. 7.6%	50	21-26	Autumn/Winter	1-2
iNhibit 10-5-20 +2Fe +2Mg	U.N. 5% A.N. 5%	50	21-26	Autumn/Winter	1-2
iNhibit 12-0-24 +3Fe +2Mg	U.N. 11.4% A.N. 0.6%	60	21-26	Autumn/Winter	1-2

St Annes Old Links Golf Club have been working with GBR Technology since 2015. In that time the course has faced several challenges including significant drought and pest damage. The excellent product range, service and technical expertise from GBR Tech have been a major contribution to overcoming these challenges and consistently delivering a championship standard Links Golf Course. We are looking forward to continuing our working relationship with GBR Tech as we aim for further improvements in the quality and conditioning of the golf course in the future.

Greg Wellings

Course Manager

St Annes Old Links Golf Club



Granular Organic Fertilisers

Our organic range utilise either plant based or chicken litter based sources to provide plant nutrition during the growing season.

Greens Grade - (1-2mm) mini organic fertilisers

Product Name	Analysis	Treat Rate (g/m²)	Field Longevity (Weeks)	Season	Granule Size (mm)
V-Pro Organic Mini 7-2-5	50% Plant Based 2% AN 5.5% Amino Acid +2% MgO +8% CaO	35-50	4-6	Spring/Autumn	1-2
V-Pro Organic Mini 10-0-4	100% Plant Based 11% Amino Acid	35-50	4-6	Spring/Autumn	1-2

Fairway/Outfield/Sports Pitch graded (2-3mm)

Product Name	Analysis	Treat Rate (g/m²)	Field Longevity (Weeks)	Season	Granule Size (mm)
V-Pro Organic 7-14-7	7-14-7	35-50	4-6	Spring/Autumn	2-3
V-Pro Organic Mini 10-0-4	100% Plant Based 11% Amino Acid	35-50	4-6	Spring/Autumn	2-3

Organic Granular

Product Name	Analysis	Treat Rate (g/m²)	Field Longevity (Weeks)	Season	Granule Size (mm)
V-Pro CL 5-3-8 Organic	5-3-8 Chicken Litter	35-50	4-6	Spring/Autumn	1-2

Liquid Fertilisers - High Nitrogen

Product Name	Analysis	Nitrogen Source	Treat Rate (litres/Ha)	Season
GBR Liquid High N +4%MgO	31-0-0 +4% MgO	U.N: 15-9% A.N: 6.1% N.N: 9.2%	10-20	All year
S-T-R-E-T-C-H-U-R.....N (Controlled Release)	28-0-0	U.N: 16.8% Methylene Urea N: 11.2%	20-40	Spring/Summer

Liquid Fertilisers - with bio-stimulant (contains 5% of 40% fulvic acid liquid)

A range of liquid fertilisers to suit most needs. This liquid fertiliser range has been put together to cover all eventualities of feeding amenity turf throughout all seasons. Fertilisers are made using high quality ingredients and are compatible with many other bio-stimulants and amenity liquid products, however jar tests are always recommended to ensure no precipitates form.

Product Name	Additional Information	Treat Rate (litres/Ha)	Season
V-Pro 21-0-0 Liquid	+ Fulvic Acid & TE's	25-50	Spring/Summer
V-Pro 12-0-8 Liquid	+ Fulvic Acid & TE's	25-50	Spring/Summer
V-Pro 4-2-12 Liquid	+ Fulvic Acid & TE's	25-50	Autumn/Winter

Soluble Fertilisers

Water soluble fertilisers are more competitively priced than liquid fertilisers and are a good option for those who are prepared to make up their own solutions prior to spraying. Our range of products are well formulated flowable powders for ease of use and each contains magnesium plus trace elements.

Product Name	Nitrogen Source	Additional Information	Treat Rate (Kg/Ha)
28-6-12 Soluble	U.N: 23% A.N: 2% N.N: 3.4%	1.6% MgO + Fe + trace elements	25-50
15-7-30 Soluble	U.N: 8.5% A.N: 1.4% N.N: 5.1%	1.6% MgO + Fe + trace elements	25-50
22-7-22 Soluble	U.N: 6.3% A.N: 3% N.N: 12.7%	1.6% MgO + Fe + trace elements	25-50
12-6-36 Soluble	A.N: 0.5% N.N: 11.5%	1.6% MgO + Fe + trace elements	25-50
Yara Kristalon White Label 15-5-30	A.N: 3.7% N.N: 11.3%	3% MgO + trace elements	25-50
Yara Kristalon Scarlet Label 7.5-12-36	N.N: 7.5%	4.5% MgO + trace elements	25-50

Straights and Trace Elements

GBR Technology supply a range of straights direct from our warehouse in varying quantities from single bags up to pallet lots. We offer competitive prices. Straights offer a very cost effective way to apply nutrients by dissolving prior to spraying. GBR source Yara grades in many cases, which offer excellent quality.

Grade	Analysis	Description	Pack size
Ammonium sulphate	21-0-0	21% nitrogen – a high quality white crystalline grade. A cost-effective nitrogen source for growth and deep green-up. Contains 24% sulphur improves colour and density of turf.	25kg bag
Yara Urea Prills	46-0-0	Free flowing white prills (prill size 1-3mm) which dissolve quickly in water without any residues.	25kg bag
Yara Krista MAP (Mono Ammonium Phosphate)	12-61-0	Free flowing, highly soluble crystals.	25kg bag
SoluMOP (Muriate of Potash -Potassium Chloride)	0-0-60	Free flowing, highly soluble crystals. MOP is a common constituent of liquid fertilisers for turf grass.	25kg bag
Yara Krista K (Potassium Nitrate)	13-0-46	Fully water soluble fine crystalline powder which dissolves quickly without any residues.	25kg bag
Yara Krista SOP (Potassium Sulphate) 18%S	0-0-51	Fully water soluble fine crystalline powder which dissolves quickly without any residues.	25kg bag
Yara Calcinit (Calcium Ammonium Nitrate) 19%Ca (26.3% CaO)	16-0-0	Fully water soluble fine granular material which dissolves quickly without any residues. 14.4% Nitrate N, 1.1% Ammoniacal N.	25kg bag
Yara Krista Mag (Magnesium Nitrate) 15%MgO	11-0-0	Fully water soluble fine crystalline powder which dissolves quickly without any residues.	25kg bag
Yara Krista Mgs (Magnesium Sulphate) 16%MgO 13%S		Fully water soluble fine crystalline powder which dissolves quickly without any residues.	25kg bag
Solufeed TEC-SF – Soluble MgO + Trace Elements		Soluble free flowing powder will deliver magnesium and trace elements. Has the following assay: MgO 24.29%, B 0.12%, Cu (chelated) 0.13%, Fe (chelated) 1.01%, Mn (chelated) 0.76%, Mo 0.03%, Zn (chelated) 0.30%	20kg bag
GBR TE Pack – Soluble Chelated Trace Elements		Super soluble free flowing powder will deliver iron and trace elements. Has the following assay: B 0.92%, Cu (chelated) 0.23%, Fe (chelated) 8.27%, Mn (chelated) 2%, Mo 0.15%, Zn (chelated) 1.16%. Sodium Free. Applied monthly at 1.6kg/Ha to correct deficiencies or at 0.8kg/Ha as a maintenance dose in 300-600L water.	10kg tub
Liquid Manganese (15% Mn)		A liquid formulation of manganese for rapid leaf uptake and maximum plant availability. Apply at 5 litres per hectare to remedy deficiency and severe stress or 2.5 litres per hectare for maintenance in 300-400 litres of water.	5 litre

The results I have found since using GBR soluble straights and the advice given has been hugely beneficial. Peter is extremely knowledgeable and explains how the products work in conjunction with biostimulants such as seaweed and fulvic acid. I started using GBR products last year and have been very pleased with the results. Very little disease in the winter and all my greens looking good and performing well. I have been using mainly soluble straights since the middle of last year and I have seen steady and consistent improvements in all my greens.

Andy Hinton

Bowling Green Contractor

Birmingham

Salt Index and How to Calculate it for Solutions of Straights

Salt Index and How to Calculate it for Solutions of Straights

Osmosis is the diffusion of water from an area of high water concentration to one of low water concentration across a selectively permeable membrane. A plant cell wall is such a membrane and the salt index of a fertiliser will give a clue to how water will flow across the cell wall.

With a high salt index fertiliser outside of the cell wall then water will move from within the cell to outside of the cell in order to attempt to level up the water concentrations. This can have a very negative effect on the cell.

Water moving into a plant cell will push the cell membrane against the cell wall generating turgidity (it does this by enlarging the vacuole within the cell) but when enough water moves out of the cell, the cell will shrink and the membrane will move away from the cell wall – the cell will lose it turgidity – the process is called 'plasmolysis' and a plasmoid cell is unlikely to survive.

High salt index fertilisers can thus potentially do damage affecting plant vigour or even giving rise to yellowing or browning of the leaf. The salt index is a numerical value that can be calculated for a fertiliser and this can give an indication on the potential damage that can be done to plant cell walls – in other words how well the plant can tolerate the fertiliser solution.

Salt Index of common fertilisers are given in the table below:

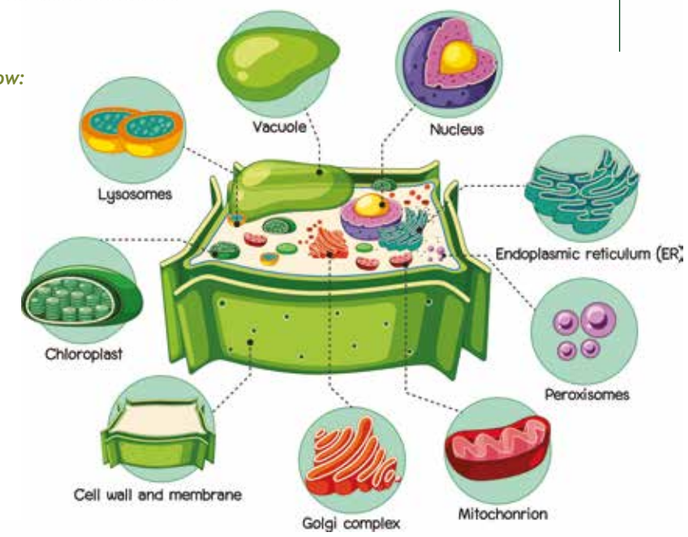
Compound	Salt Index
Ammonium Nitrate	105
Ammonium Sulphate	69
Calcium Nitrate	53
Magnesium Sulphate	44
Methylene Urea	4
Mono Ammonium Phosphate (MAP)	30
Potassium Chloride (MOP)	116
Potassium Nitrate	74
Potassium Sulphate	46
Sodium Chloride	153
Urea	75

The reference point for salt index is sodium nitrate – this is given a salt index of 100.

A high salt index fertiliser solution is more likely to do damage to:

- Seedlings and young leaf tissues
- When using high concentration foliar feeds
- When the weather conditions are hot and dry

Plant Cell



To calculate a relative salt index of a mix of straights in solution you can multiply the salt index of the component by its percentage in the mix and then add up the contributions from each component to get a relative salt index for the solution.

As an example if you are mixing the following in 400 litres (kg) of water:

Ammonium Sulphate 6kg

Urea 8kg

Mono Ammonium Phosphate (MAP) 2.5kg

Muriate of Potash (MOP – potassium chloride) 6.25kg

We'll have a total mix weight of 400 + 6 + 8 + 2.5 + 6.25 = 422.75 kg. The table below then shows how we arrive at the relative salt index of the solution.

Straight	Mass Used kg	Salt Index of Straight	% in mix	Salt Index x % (divided by 100)
Ammonium Sulphate	6	69	1.4 (i.e. 6 divided by 422.75 as a %)	0.966
Urea	8	75	1.9	1.425
MAP	2.5	30	0.5	0.15
MOP	6.25	116	1.4	1.624
Water	400	0	94.6	0
TOTAL:	422.75	-	100	**4.165**

So from the above we have arrived at a salt index of our spray solution of 4.165. To give a comparison the salt index of sea water is roughly 5.4.

Of course what level of salt index is actually going to do damage will depend upon a number of things not least how hot and dry it is (water evaporating during and after spraying will of course concentrate up the salts and the salt index will go up – irrigation or rain will reduce it).

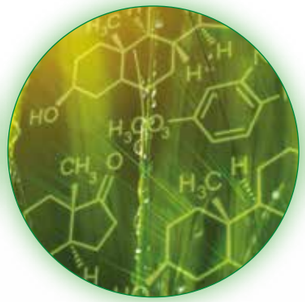
But it's no bad thing to calculate the salt index of some of your typical sprays to get an idea of how they compare and to keep an eye on the results you get.

Soil and Leaf Analysis

We are able to offer a comprehensive soil and leaf analysis service (Yara's Lancrop Laboratories) which can provide assistance in designing your fertiliser programme. The reports detail the results obtained along with recommended levels. Some of the tests available are covered in the table below:

Code	Analysis	Parameters
BSE - M3	Broad Spectrum Extra Soil (Mehlich 3)	P,K,Mg,pH,L.R,Ca,S,Na,Mn,Cu,Fe,Zn,Mo,B,CEC,OM,Sand%,Silt%,Clay%,Soil Texture Classification
BS	Broad Spectrum - Soil	P,K,Mg,pH,L.R,Ca,S,Na,Mn,Cu,Fe,Zn,Mo,B,CEC
S1	Basic Soil	P,K,Mg,pH,L.R
S1b	Basic Soil Plus	P,K,Mg,pH,L.R,Mn,Cu,B,S
OM	Organic Matter	Organic Matter Content
SA14	Soil Texture	Soil Texture Classification
BSL	Broad Spectrum - Leaf	N,P,K,Mg,Ca,S,Mn,Cu,Fe,Zn,Mo,B
NL	Nitrogen only – Leaf	N

Key: P = Phosphorus, K = Potassium, Mg = Magnesium, pH is the measure of acidity or alkalinity, L.R. = Lime Requirement, Ca = Calcium, S = Sulphur, Na = Sodium, Mn = Manganese, Cu = Copper, Fe = Iron, Zn = Zinc, Mo = Molybdenum, B = Boron, CEC = Cation Exchange Capacity, OM = Organic Matter.



... our
Biostimulant Range

Introduction

Biostimulants are a category of product that have been around for some time. However, currently it is fair to say that there is greater emphasis on what these products can do as the number of plant protection products available become ever more constrained. Increasing the turf plants own health and that of symbiotic species with the aim of increasing resistance to pathogens is certainly a goal worth striving for.

A biostimulant is distinct from a fertiliser and a plant protection product – a biostimulant should not have any direct action on diseases or pests and thus is not regulated by the same framework covering plant protection products.

A biostimulants main role is also not to provide NPK and other elemental nutrients or micronutrients although in practice some biostimulants do contain these elements that can assist with general fertilisation e.g. trace elements in seaweed and carbon sources from seaweed and molasses.

Many biostimulants when applied to the soil (or a plant via foliar application) can increase resistance to abiotic stress, they can increase plant yield, vigour or quality and they may be in the form of a diverse range of natural or synthetic materials or even micro-organisms.

Of course what a biostimulant can do for you needs to be carefully assessed and results evaluated to gauge whether a programme is worth continuing with or modifying in some way.

Biostimulants may act with a wide range of different mechanisms and it's useful to understand what these mechanisms are and whether they may be of relevance for you. However, frequently, biostimulants will have effects for which the mechanisms are not known or not well understood.

Common products sold as biostimulants include seaweeds and their extracts, humic and fulvic acids, molasses/sugars, amino acids, soil oxidants, phosphite solutions, chitin derivatives and microbes (bacteria and fungi).

Results of application can be mixed in some cases and it should be noted that benefits seen in research on some plant species may not necessarily transfer to grass species – this fact should be borne in mind when studying research papers relating to other crops. Also, it's important, in order to see results, that suitable application rates are used. Products exist on the market with added biostimulants at sub-effect levels and it is worthwhile considering whether the extra cost for these additions justify the price charged. However with these reservations made, there are, of course, many biostimulant products being successfully used on turf grass.

Let's look at some of the product types:

Seaweeds:

Ascophyllum nodosum is a seaweed that naturally contains macro and micro nutrients but also contains plant hormones and is rich in cytokinins. Higher cytokinin levels (relative to auxins) can stimulate shoot growth. Most seaweed products sold in the UK are based on extracts of Ascophyllum nodosum.

Eckalonia maxima is a species native to southern oceans – this seaweed is rich in auxins and the higher auxin to cytokinin ratio present is promoted to stimulate root growth. A key brand here is Kelpak.

Humic and fulvic acids:

These are natural decay products of dead plant material – they are extracted under alkaline conditions from humus – humic acid precipitates upon acidification whilst fulvic acid remains in solution at all pHs – they are highly complex mixtures largely of carboxylic and phenolic organic compounds

Molasses:

Molasses is a by-product of sugar refining – it contains sugars itself as well as other macro and micro elements. Sugars are also a rich source of carbon and can help achieve a desirable nitrogen to carbon ratio in fertilisation programmes.

Sugars can be an easy food source for microbes, releasing quick energy (as they do for humans!).

Soil oxidants:

Oxidation in chemistry is defined as the removal of electrons. In nature on earth, since oxygen gas is the predominant oxidising agent in the atmosphere, then living organisms have evolved mechanisms to utilise oxygen in energy pathways. Most soil oxidants work indirectly by stimulating soil microbes to produce oxygen, although some soil oxidants have been known to contain hydrogen peroxide that directly decomposes and generates small amounts of oxygen. The formulations often contain nitrates and so will show a green up and plant growth effect. Interestingly too, in soils with a low redox potential (redox = reduction-oxidation; redox potential indicates how aerobic the soil is), the nitrogen in nitrate form maybe the next most potent soil oxidant after oxygen. Nitrogen in nitrate exists in the +5 oxidation state – so it can take 2 electrons from other atoms (and remember chemical oxidation is defined as the removal of electrons) and convert to the +3 oxidation state – this type of oxidation would only be possible in low redox potential soils. Sulphate would be the next most potent soil oxidant as the redox potential drops further, but at this stage anaerobic sulphate reducing bacteria are active here and the reaction product of this oxidation are toxic sulphides (hydrogen sulphide the rotten eggs gas – which can then also react with iron in the profile to form black layer). Soil oxidants will themselves not work miracles – they may help tip the balance but are, of course, no substitute for good cultural practice.

Phosphite:

Phosphite supplied as a solution of potassium phosphite (or ammonium phosphite) is regularly used to help reduce incidence of fusarium patch. Phosphite itself is well translocated within the plant but is not believed to be a form of P than can be used to replace phosphate P for nutritional uptake in turf grass. Phosphite at certain levels of use can directly act on a pathogen although applications are normally made at levels below this and it is believed that the action then is one of stimulating the turf plants own natural defences. Phosphite converts slowly to phosphate in the soil environment.

Amino Acids:

Amino acids are the building blocks of proteins and these make up various structures and components of plants and animals including cell walls in plants. Nitrogen uptake in plants is generally converted to amino acids and then much of these into proteins as well as incorporation into DNA. Plants need various amino acids many of which they can synthesize themselves – however this synthesis requires energy and during periods of high stress it is believed that supplying some amino acids directly will reduce the abiotic stress on the plant.

Chitosan:

Chitosan is a derivative of chitin. Chitin itself is biosynthesized in nature and is highly abundant – it makes up the exoskeletons of many insects and crustaceans and also found in the cell walls of some fungi. Chitosan is a soluble material supplied in aqueous solution.

Chitosan is made by a deacetylation process (a type of chemical synthesis reaction that removes a chemical group) on chitin and may typically come from crustacean chitin (e.g. crabs shells etc.) or from fungal chitin. Chitosan has been extensively studied and has a number of bioactive effects.

Microbes:

Microbes in the form of bacteria and fungi can bring positive effects by breaking down plant material and releasing back nutrients – this gives nutritional benefits to the turf plant as well as reducing thatch. Certain fungi can also work symbiotically with plants to exchange benefits (nutrition and energy) and it is also believed that in many cases the fungi can help protect its symbiotic partner against pests and diseases.

Tonivit

Manufactured by Arysta Lifescience, Tonivit utilises a unique extract of ascophyllum nodosum called GA142. In research Tonivit has been shown to increase nutrient uptake and chlorophyll production and leads to increased tillering and root mass along with greater vigour of turf grass.

In Tonivit the GA142 active ingredient is combined with support ingredients which assist its mode of action. GA142 is made by a patented cell burst process and double filtered to remove non active ingredients giving a product that gives effects at low treat rates and has wider tank mix compatibility.

Tonivit was developed primarily for use during turf establishment but will bring the majority of its benefits equally well to established turf.

Benefits and Features

- Enhances nutrient uptake
- Speeds up the establishment of new turf
- Increases chlorophyll production
- Increases root mass and tillering
- Improves plant vigour
- Good compatibility in many tank mixes
- Low treat rates

Application

Apply every 2 weeks at 1 litre per hectare or monthly at 1-2 litres per hectare. Do not tank mix with herbicides. Product is usually applied from early spring to late autumn although can be applied year round.

Pack sizes available

5 litre

Zone	Tonivit	Water Volume	Area
Greens/Tees/ Fairways/ Sports Pitches	1-2 litres	300-600 litres	1 hectare
Bowling Greens	150-300ml	45-90 litres	1500m²

Double Edge

Similar in nature to Tonivit, Double Edge derives its action from the GA142 extract. Double Edge is primarily targeted at maintenance of sports turf. It contains additional vegetable derived amino acids carefully selected to enhance the action of GA142.

Benefits and Features

- Good compatibility in many tank mixes
- Enhances nutrient uptake
- Improves plant vigour
- Increases root mass and tillering
- Increases chlorophyll production
- Low treat rates

Application

Apply every 2 weeks at 1 litre per hectare or monthly at 1-2 litres per hectare. Do not tank mix with herbicides. Product is usually applied from early spring to late autumn.

Pack sizes available

5 litre

Zone	Double Edge	Water Volume	Area
Greens/Tees/ Fairways/ Sports Pitches	1-2 litres	300-600 litres	1 hectare
Bowling Greens	150-300ml	45-90 litres	1500m²

Kelpak Root growth stimulant

Kelpak is a liquid seaweed extract from the brown kelp Ecklonia maxima found on the west coast of South Africa. Kelpak is produced using a cold extraction cell burst method that does not destroy the plant hormones. Light resistant containers preserve the more delicate plant hormones.

The key attributes of Kelpak include its very high auxin to cytokinin ratio and a cocktail of natural plant growth regulators that provide a 'soup' of actives. Kelpak's natural elicitors trigger root development and this in turn can lead to improved nutrient uptake and a more healthy sward.

Benefits and Features

- Improved vigour of root and shoot growth
- Relieves turf stress
- Maintains vibrant and healthy sward

Pack sizes available

5 litre, 25 litre

Zone	Kelpak	Water Volume	Area	Notes
Greens/Tees	5-10 litres	300-600 litres	1 hectare	Can be applied with surfactant. Kelpak will not be effective at dilutions below 0.2%
Fairways/ Sports Pitches	2-5 litres	300-600 litres	1 hectare	
Bowling Greens	750ml-1.5 litres	45-90 litres	1500m²	

GBR Liquid Seaweed

22% cold extracted seaweed from Ascophyllum Nodosum. Rich in amino acids as well as cytokinins and gibberellins. Also provides a carbon source to the soil food web.

Benefits and Features

- A balanced source of macronutrients, trace elements and organic carbon
- Stronger root system development
- Improved tolerance to environmental stresses and diseases
- Increases the activity of beneficial microbes

Zone	GBR Liquid Seaweed	Water Volume	Area
Greens/ Tees/Fairways/ Sports Pitches	10-20 litres	300-600 litres	1 hectare
Bowling Greens	1.5-3 litres	45-90 litres	1500m²

Application

Apply monthly during the growing season.

Pack sizes available

20 litre, 200 litre

GBR Soluble Seaweed Powder

Fully cold water soluble Ascophyllum nodosum. A cost effective way to apply seaweed.

Benefits and Features

- As per GBR Liquid seaweed but in a dried soluble powder

Application

Apply monthly during the growing season.

Pack sizes available

2kg tub (treats 2 Ha)

10kg tub (treats 10 Ha)

Zone	GBR Soluble Seaweed Powder	Water Volume	Area
Greens/ Tees/Fairways/ Sports Pitches	1-2 kg	300-600 litres	1 hectare
Bowling Greens	150-300g	45-90 litres	1500m²

GBR Humic Acid Liquid

High quality 100% liquid bio-humate solution specially designed for amenity turf.

Benefits and Features

- Stimulates root development
- Increase nutrient uptake
- Increase tolerance to abiotic stress

Application

Apply monthly as required. Ideal for newly seeded areas.

Pack sizes available

20 litre

Zone	GBR Humic Acid Liquid	Water Volume	Area
Greens/Tees/ Fairways/Sports Pitches/Newly seeded areas	10 litres	300-600 litres	1 hectare
Bowling Greens	1.5 litres	45-90 litres	1500m²

GBR Fulvic Acid Liquid

Can be applied throughout the season. Contains 40% Fulvic extract of humates.

Benefits and Features

- Increases cationic exchange capacity of the rootzone
- Aids the uptake of nutrients
- Retains moisture and nutrients in the rootzone for longer
- Stimulates root development and enhances plant growth in general
- May stimulate microbial activity

Application

Apply monthly as required.

Pack sizes available

5 litre, 10 litre

Zone	GBR Fulvic Acid Liquid	Water Volume	Area
Greens/Tees/ Fairways/ Sports Pitches	2.5-5 litres	300-600 litres	1 hectare
Bowling Greens	375-750ml	45-90 litres	1500m²

GBR Fulvic Acid Soluble Powder

Can be applied throughout the season. Contains 70% Fulvic Acid.

Benefits and Features

- Increases cationic exchange capacity of the rootzone
- Aids the uptake of nutrients
- Retains moisture and nutrients in the rootzone for longer
- Stimulates root development and enhances plant growth in general
- May stimulate microbial activity

Zone	GBR Fulvic Acid Powder	Water Volume	Area
Greens/Tees/ Sports Pitches	1-2kg	300-600 litres	1 hectare
Bowling Greens	150-300g	45-90 litres	1500m²

Application

Can be applied throughout the year. Fully cold water soluble.

Pack sizes available

2kg & 10kg tub

Fielder Fighter (phosphite)

Analysis: 5-31-11. W/V (equates to 34.5% W/V as phosphite anion). A liquid phosphite solution containing potassium and ammonium phosphite salts. All of the P in this product is in phosphite form. Phosphite is used to enhance the plants own defences and to give plants stress relief. Phosphite is not a substitute for the phosphate form of phosphorus for fertilisation.

Benefits and Features

- Improve nutrient uptake and assimilation
- Increase abiotic stress tolerance
- Promote root growth

Zone	Fielder Fighter (Phosphite)	Water Volume	Area
Greens/Tees/ Sports Pitches	5 litres	400-600 litres	1 hectare
Bowling Greens	750ml	60-90 litres	1500m²

Application

Apply monthly when there is growth.

Pack sizes available

10 litre

Optamino 25

Optamino 25 is a powerful liquid concentrate of 25% amino acids (18% free aminos) that are derived from enzymatically digested plant protein with the optimum pH of 5-6. Aminos chelate, promote, activate and save plant nutrients & energy. Contains 4% organic nitrogen and trace elements and 15% ammonical nitrogen.

Benefits and Features

- Aminos, chelate, promote, activate and save plant nutrients and energy

Application

Apply all year round.

Pack sizes available

5 litre, 10 litre, 20 litre

Zone	Optamino 25	Water Volume	Area
Greens/Tees/ Sports Pitches	2-5 litres	300-500 litres	1 hectare
Bowling Greens	300-750ml	45-75 litres	1500m²

Oxy-Stim

Helps promote aerobic soil conditions by stimulating microbial activity. Oxy-Stim can increase the redox potential of soils that are suffering from a low redox potential.

Application

Apply monthly as required.

Pack sizes available

10 litre

Zone	Oxy-Stim	Water Volume	Area
Greens/Tees/ Sports Pitches	2-5 litres	200-600 litres	1 hectare
Bowling Greens	300-750ml	30-90 litres	1500m²

GBR Fungal Chitosan (5-6% Liquid)

Chitosan (a derivative of chitin) is a potentially exciting biostimulant available for use on turf grass. It has been extensively studied on crops and results published in many peer reviewed journals. Some quite significant benefits have been discovered. In addition to its direct effects on plant nutrition and growth stimulation, chitosan has been found to induce plant defences and stimulate the activity and growth of beneficial microbes.

Benefits and Features

- Increases resistance to abiotic stress (drought, salinity, cold)
- May increase resistance to fungal pathogens by eliciting plant defences
- Various plants treated with chitosan have been shown to have lower incidence of fusarium wilts

Zone	GBR Chitosan	Water Volume	Area
Greens/ Tees/Sports Pitches	2-10 litres	200-400 litres	1 hectare
Bowling Greens	300-450ml	30-60 litres	1500m²

Application

Apply monthly as required.

Pack sizes available

5 litre, 10 litre

V-Pro Thatch Degrader

Contains natural Phanerochaetes and Geomyces fungi and Trichoderma microbes with a stimulant powder.

Benefits and Features

- Reduces thatch so create better underlying soil conditions
- Thatch breakdown releases nutrients for turf uptake
- Trichoderma has the potential to form a symbiotic relationship with the turf plant to bring stress relief and assist in protection against disease

Zone	V-Pro Thatch Degrader	Water Volume	Area	Notes
Greens/ Tees/Sports Pitches	330 grams	200-300 litres	1 hectare	Soil temperature needs to be 8°C and above
Bowling Greens	50g	30-45 litres	1500m²	

Application

Dissolve in water prior to spray application. Apply when soil temperature is 8°C and above. Apply monthly.

Pack sizes available

1kg tub

We've been using Hydrozone on greens at Farnham now since 2011. Hydrozone has given us very good results, performing at least as well as previous products we have used. Hydrozone is an important part of our water management programme making the best use of our irrigation system. We have also been a long term user of Forti-Fe and find this product gives the green-up we desire along with a bit of N to tickle the greens along through the winter.

Rupert Lawrence

Course Manager

Farnham Golf Club

Tierra Boost

An advanced organic biostimulant and fertiliser with NPK analysis 5-2-4. Tierra Boost also contains 18% amino acids, 23% Fulvic acid and 4% sugars. GBR's special surfactant system dramatically enhances uptake to give an exceptional product which is being used by a fast growing number of customers. Low salt index, trace elements and sugars contributes to healthy soil life and thus to healthy plants. Tierra Boost nutrients are natural products and do not contain synthetic fertilisers. Fulvic and amino acids aid CEC and stress recovery respectively.

Tierra Boost is formulated for spraying as well as drip irrigation and will not block in-line filters. Tierra Boost is very economical and has a wide range of nutrients. Correct application will restore the balance in the soil and reinforce plant vitality.

Product also contains:
Organic Matter 45.5%
pH 5.5-6.5
Magnesium (MgO) 0.4%
Calcium (Ca) 0.2%
Sulphur (SO3) 3.4%
Trace elements Fe, Zn, B, Mn, Cu, Mo

Benefits and Features

- Fertiliser and biostimulant in one product
- Total package of micro-nutrients
- Less leaching of minerals
- Fast available nutrients, when applied as a foliar treatment
- General product that works with the natural cycle
- Increases resistance to stress

Application Information

Dilute in further water prior to spray application. Apply every 3-6 weeks as required. Apply to dry turf. Do not apply over frost. For use spring to autumn.

Zone	Tierra Boost	Water Volume	Area
Greens/Tees/ Sports Pitches	10-25 litres	300-600 litres	1 hectare
Bowling Greens	1.5-3.75 litres	45-90 litres	1500m^2

Protect from freezing temperature. Store containers above 8°C to maintain full actives in solution. Shake or stir container before use if using part containers – if this is not possible for large packs it is recommended to purchase 10 or 20 litre packs

Availability

5 litre, 20 litre, 120 litre, 200 litre drums

After using different dew controls over the years, with little success, we have changed to GBR Endew Plus. We have had great results with many other of their products, and this product was the same. It lasted 5 weeks and also kept snow off – we will be using in spring and autumn to lower our disease pressure

Grant Moran
Head Greenkeeper
Mortonhall Golf Club

V-Pro Astrom

A balanced liquid feed plus molasses and chelated iron. Designed to feed both the grass plant and soil microbes and promote growth, green-up and provide macro nutrients in both inorganic form and macro and micro nutrients from natural sources.

Typical analysis: w/v 7% N (nitrate 2.1%, ammonium 1.4%, ureic 3.5%) + additional 1% protein nitrogen, iron 2% (as ferric DTPA chelate). Contains various other macro and micro nutrients from natural sources (especially potassium, calcium and magnesium). Contains glucose derived surfactant to assist uptake.

Features and Benefits

- Feeds grass plant as well as soil microbes
- Promotes growth and green-up

Application

- Can be applied with wetting agent or penetrant (always jar test to check for compatibility)
- Can be applied year round every 2-4 weeks as required
- Can be used as a foliar feed or root drench

Zone	VP Astrom	Water Volume	Area
Greens/Tees	20 litres	300-600 litres	1 hectare
Fairways	10-20 litres	200-600 litres	1 hectare
Sports Pitches	20 litres	300-600 litres	1 hectare
Bowling Greens	3 litres	45-90 litres	1500m²

Pack sizes available

10 litre, 200 litre, IBCs

GBR Molasses

Concentrated molasses providing a source of sugars and protein. Molasses feeds soil microbes and also provides a valuable source of carbon and macro nutrients to the profile.

Typical analysis: K: 5.1%, P: 0.1%, Ca: 0.7%, Mg: 0.4%

Features and Benefits

- Provides concentrated source of sugars and protein
- Feeds soil microbes and gives valuable carbon and macro nutrients to the profile

Application

Can be applied throughout the year.

Pack sizes available

5 litre, 10 litre, 200 litre

Zone	GBR Molasses	Water Volume	Area	Application
Greens/Tees	20-50 litres	400-600 litres	1 hectare	Apply monthly from March – Nov when soil temp is 8°C and above. Initial applications can be made at 50-100 litres/Ha to start the season.
Sports Pitches/ Fairways	10-20 litres	300-600 litres	1 hectare	Apply monthly from March – Nov when soil temp is 8°C and above.
Bowling Greens	3.0-7.5 litres	60-90 litres	1500m²	Apply monthly from March – Nov when soil temp is 8°C and above.

GraVia Silicon

A micronized mineral suspension that promotes shoot rigidity which can improve quality of cut and aid seed head removal during mowing. Silicon can also strengthen cells and improve yields. Analysis w/v: Silicon: 12.5%, Boron: 0.7%, Iron: 0.3%. Application: Use at 5 litres per hectare.

This growth habit can be associated with a cleaner and more uniform height of cut, increased ball roll due to reduced friction on lateral growth and improved presentation. While silicon can also be used to improve resistance to both abiotic and biotic stresses.

Benefits and Features

- Improved quality of cut
- Better seed head removal
- Good tank mix compatibility (unlike potassium silicate)
- Cell strengthener
- Biostimulant
- Increases resistance to stress

Application Information

Apply at 5 litres per hectare in a minimum of 400 litres of water.

Availability

5 litre, 20 litre

Zone	GraVia	Water Volume	Area
Greens/Tees/ Sports Pitches	5litres	400-600 litres	1 hectare
Bowling Greens	750ml	45-90 litres	1500m²
Protect from freezing. Agitation should be maintained throughout spraying.			

TurfGard (Garlic)

A naturally based plant health promoter based on garlic extract and kelp. To deter a range of pests and help the plant to overcome symptoms of pest attack. TurfGard is not a pesticide and has no pesticidal activity but makes the crop less attractive to attack. Use prior to the onset of pest infestation.

Benefits and Features

- Helps deter pests by making crop less attractive to them
- Can help plant overcome symptoms of a pest attack

Application

Apply at 5L per hectare fortnightly in 450-600L as a root drench. Can be used at 10L per hectare in more severe cases. Compatible with GBR wetting agents and Intensive Wetter.

Zone	TurfGard (Garlic)	Water Volume	Area
Greens/Tees/ Fairways/Sports Pitches	5 litres	450-600 litres	1 hectare
Bowling Greens	750ml	68-90 litres	1500m²

Pack sizes available

5 litre

MycoTurf

Natural microbial package containing mycorrhizae, bacillus and other beneficial microbes for enhanced germination, disease resistance, turf health, reduced stress and improved nutrient uptake. Glomus spp. Bacillus spp. Pseudomonas sp. Paenibacillus sp. Azotobacter sp. Azospirillum sp. Beijerinckia sp.

Benefits and Features

- Stress Reliever
- Releases locked up nutrients
- Optimised package of microbes

Application Information

Apply at 500g-1kg per hectare in 300-600 litres of water.

Availability

1kg Tub

Bacillus Powder

A soluble blend of Bacillus sp. and Paenibacillus sp. which are plant growth promoting Rhizobacteria for enhanced rooting, health and biomass. These microbes are able to thrive in stressful environmental conditions and support soil biology.

Benefits and Features

- Helps enhance root, health and biomass of plant

Application

Apply at 250-500g per hectare in 300-600L of water.

Pack sizes available

1kg Tub

Zone	Bacillus Powder	Water Volume	Area
Greens/Tees/ Fairways/Sports Pitches	250-500g	300-600 litres	1 hectare
Bowling Greens	37.5-75g	45-90 litres	1500m²

Compost Tea Activator

Compost Tea Activator contains fermented plant extract that is rich in amino acids, organic matter and humic & fulvic acid.

Benefits and Features

- A rich source of nutrients for both bacterial and fungal brews

Application

As a brew, use at 5-15 litres to 1000 litres of brew.

Pack sizes available

20 litre

Zone	Compost Tea Activator	Water Volume	Area
Greens/Tees/ Fairways/Sports Pitches	5-15 litres	1000 litres	1 hectare
Bowling Greens	750ml-2.25 litres	150 litres	1500m²

Tri-5B

A soluble powder containing a blend of beneficial microbes (plus Trichoderma) that aid in fixing nitrogen, solubilising phosphate (making it available to the plant) and aids in the degradation of organic matter. This blend of microbes also competes with plant pathogenic microbes for resources and space within the rhizosphere and can limit their development and subsequent damage to the plant. Contains: Azospirullum sp, Azotobacter sp, Bacillus sp, Beijerinckia sp, Paenibacillus sp, and Trichoderma Harzianum sp.

Benefits and Features

- Aids the degradation of organic matter
- Microbes help fix nitrogen and solubilise phosphate making if available to the plant

Application

Apply at 250-500g per hectare in 400-600 litres of water.

Pack sizes available

1kg Tub

Zone	Tri-5B	Water Volume	Area
Greens/Tees/ Fairways/Sports Pitches	250-500g	400-600 litres	1 hectare
Bowling Greens	37.5-75g	60-90 litres	1500m²

Fish Hydrolysate

A balanced organic liquid 8-8-7 + Trace elements fertiliser for healthy growth and colour. Readily available proteins and nutrients improve soil fertility and boost soil microbes. Ideal for perennial grasses.

Benefits and Features

- Aids healthy growth and colour
- Improves soil fertility and boosts soil microbes

Application

Apply 5-10L per Ha in 300-600L of water all year round. Can be tank mixed. Jar test is always recommended for compatibility.

Pack sizes available

10 litre

Zone	Fish Hydrolysate	Water Volume	Area
Greens/Tees/ Fairways/Sports Pitches	5-10 litres	300-600 litres	1 hectare
Bowling Greens	750ml-1.5 litres	45-90 litres	1500m²

... our
Iron Products & Turf Hardeners Range

Introduction

Iron is one of the essential micronutrients needed for turf grass, playing a vital role in nitrogen metabolism and chlorophyll production. Additionally in sports turf, iron is used in greater quantities to green-up and harden-off the plant, inferring some protection against disease. Iron can be supplied in a variety of forms; as inorganic salts, complexed, or chelated compounds. Other divalent ions can also have a role in turf hardening.

We offer a range of liquid, soluble and spreadable turf hardeners based on the different forms of iron. We also offer a product based on calcium and magnesium divalent ions to strengthen cell walls and provide turf hardening.

Applications of many forms of soluble iron are suitable for foliar uptake.

Using iron for green-up results in minimal stimulation of leaf growth unlike the use of nitrogen for the same application.

Iron will react in nature to form compounds in one of two oxidation states – ferrous (2+) or ferric (3+). Ferric is the most stable oxidation state in nature however many ferric compounds are very insoluble and utilisation by turfgrass once converted to this state in the soil is much more difficult. Turfgrass does have mechanisms to assist in utilising insoluble iron by producing exodates that are released into the soil to chelate iron and make it available. However these mechanisms require energy, have their limits and will put turf under additional stress.

Whilst many forms of iron will tend to form into very insoluble ferric compounds once in the soil, strongly chelated iron will resist forming these very insoluble compounds.

Inorganic salts

Ferrous sulphate is an inorganic salt and a very useful and well used form of iron (highly cost effective and good for controlling moss). Good quality ferrous sulphate supplied as the mono or heptahydrate can be dissolved in water with very little initial residue and will be good for foliar uptake. After dissolving, ferrous sulphate will slowly oxidise and a dusting of brown insoluble ferric compounds will be seen falling out of solution typically within an hour – at this stage the precipitate is minimal in terms of volume and is sufficiently fine in size that it is unlikely to affect spraying – however it should be noted that once dissolved ferrous sulphate solutions should be sprayed out within a couple of hours. This oxidation and precipitation can be prevented by acidifying the tank mix (below pH 3 the oxidation is very slow) however consideration should be given if other products have also been tank mixed at the same time. Ferrous sulphate crystals should also not be stored exposed to atmosphere and part opened bags should be tightly re-sealed. Addition of surfactants can significantly assist in foliar uptake of iron – giving a greater green- up for the same amount of iron or allowing less iron to be used. Attention should be given to the scorch potential of ferrous sulphate applications especially under hot sunny conditions – adding surfactants to enhance update without reducing the amount of ferrous sulphate will increase the scorch potential.

Ferric sulphate (iron in its higher oxidation state) is also available as a high strength liquid, (up to a remarkable 19.4% Fe w/v). Such products are acidified with nitric acid and must be handled with care in the concentrated form.

Complexed and chelated iron:

Certain chemical species have the ability to form a 'ligand' bond with certain metals, including iron. If the species forms one ligand bond per molecule this is normally referred to as a 'complex'. If the chemical species form multiple bonds per molecule it's referred to as a chelate. Chelates tend to offer greater protection than complexes in preventing iron from undergoing unwanted reactions. Also, each particular chelate offers different degrees of binding power and thus different abilities to protect iron from undergoing unwanted reactions, leaving it less bioavailable. The binding power of the chelate also varies with pH. Some chelates have the ability to bind to iron so tightly that the ratio of bound iron to unbound iron may be 10^{38} (that's a 1 followed by 38 zeros – a very large number indeed) to 1. Due to the fact that reactions are in what's termed 'dynamic equilibrium', a high level of chelating power is preferred.

Let's take an example in aqueous solution. Citric acid – Fe^{2+} has a stability constant of 10^3 (1 with 3 zeros after it i.e. 1000). So there would be 1000 times more bound (chelated by citrate) iron than free iron at any one time. However that small amount of free iron reacts with hydroxyl ions in the soil to form very insoluble iron compounds – these precipitate out and this small amount of iron is taken out of solution – only chelated iron is thus left in solution – however some of this then adjusts (because the system is under dynamic equilibrium) so the ratio of chelated to non chelated iron is back to 1000 – another small amount of this free iron reacts and precipitates and the process continues, gradually precipitating out most of the iron. The reality is that this doesn't happen as chunks just described – it's a continual process – free iron is adjusting to chelated iron and chelated iron is adjusting to free iron all the time – just that the system is always at that ratio of 1000 to 1 at any one time and as you withdraw iron by precipitating it out the 1000 to 1 ratio is maintained in solution thus requiring more chelated iron to be converted to free iron. The speed of the process is also determined by reaction rates or what's termed 'reaction kinetics'. In soil, as opposed to aqueous solution, the processes will also depend upon moisture levels to be able to form a system (actually systems) that are in dynamic equilibrium. You can thus see that a strong chelate is preferred for long term bioavailability.

Examples of complexes and chelates along with their strengths are highlighted in the table below (a higher stability constant equates to less unwanted reactions):

	Type	Ligand bonds per molecule	Stability constant – Fe^{2+}	Stability constant – Fe^{3+}	Comments
Sulphate	Neither complex nor chelate	0	-	-	An inorganic salt
Ammonium	Complex	1	-	-	
Citric acid	Chelate	2	3.2	11.9	
EDTA	Chelate	6	14.3	25.7	Good for use up to pH 6.5
DTPA	Chelate	Up to 8	16.6	28.6	Good for use up to pH 7.8
EDDHA	Chelate	Up to 8	Data not readily available	>33 (o-o form)	Comes in 2 forms with different chelating powers

Iron Products

Many formulated liquid iron products use ferrous sulphate in combination with chelated or complexed forms. A fully formulated product will typically contain a surfactant to aid foliar uptake (and often this needs to be an acid stable surfactant), some nitrogen and a micro-nutrient package. Potassium may also be included to enhance the hardening-off effect. Forti-Fe fits into this category. Many liquid iron products will aim to provide about 6% iron weight for volume. It's very rare to find a liquid iron where all 6% of the iron is in a strongly chelated form e.g. EDTA or DTPA and Emerald Iron is pretty unusual in this respect for sales into managed sports amenity turf.

Once spray applied, iron can be taken up through the leaf and via the root system. This initial green-up would not be enhanced by using a chelated iron over ferrous sulphate however, ongoing bioavailability of iron in the rootzone would be better with a chelated product. In some cases, for example, fairway application without irrigation, then avoiding the use of ferrous sulphate in favour of chelated forms of iron with lower scorch potential may have other advantages.

Black layer

There are times when it may be desirable to avoid further additions of sulphur when applying iron. In these cases the use of ferrous sulphate and ferrous sulphate containing products would not be desirable due to their sulphur content. Emerald Iron and ACTi-Fe both offer the chance to apply iron whilst adding no significant amount of sulphur (only trace levels present). Black layer in most cases is down to the presence of iron or manganese sulphide (these compounds are black) and may be formed when anaerobic sulphate reducing bacteria act on sulphate present in the soil. However, bear in mind that sulphur is an essential nutrient and will be required at a certain level.

I am really impressed with Endew Plus. It has greatly improved the plant health, reduced the reliance on expensive fungicides, and also given us huge labour savings.

Nathan O'Sullivan

Course Manager

China Fleet Golf Club

I have been using GBR for the last 2 years. What has impressed me is the knowledge they have on all their products. Peter provides me with all the technical data needed, before a product is purchased. Competitive prices backed up by the correct information, gives me the confidence that the product is right for my purpose.

David Thompson (BSc Hons)

Head Greenkeeper

Hexham Golf Club

Reformulated for 2022

Forti-Fe liquid iron with K, Mg plus micro-nutrients

A high quality liquid iron (6%) with micro-nutrients, potassium (6%) and magnesium. For use on greens and tees to green-up and harden-off turf whilst ensuring an appropriate supply of essential micro-nutrients.

Iron is provided in the form of ferrous sulphate (chelated with citric acid and MGDA) in combination with DTPA chelate, as a trace iron source.

Around 2% of N is also included in nitrate form, further assisting green-up. A surfactant package aids foliar uptake for a faster and more pronounced effect.

Benefits and Features

- Fast and long-lived green-up
- DTPA chelate ensures long term iron availability to the plant
- Hardening-off effect
- Magnesium and, largely, chelated micro-nutrient package assist in maintaining micro-nutrients to sand-based rootzones

Composition includes:

(percentages quoted as weight for volume):

Iron sulphate/citric acid/MGDA chelate (6% total iron content). Iron DTPA chelate at trace element levels.

Fast release nitrogen: 2% N (as nitrate)

Potassium: 6%

Magnesium: 0.14%

Boron: 0.0012%

Copper: 0.0013% (supplied at EDTA chelate)

Manganese: 0.0076% (supplied as EDTA chelate)

Molybdenum: 0.00025% (non-chelated)

Zinc: 0.003% (supplied as EDTA chelate)

Pack sizes available

5 litre, 20 litre, 200 litre

MGDA - Methylglycine diacetic acid - a powerful chelating agent that stands out due to its excellent ecological and toxicological profile. MGDA is also stable over a wide pH range

Application

Dilute in water prior to spray application. Apply at 20-30 litres per hectare every 4-6 weeks. May be used year round. Apply to dry turf. Do not apply over frost.

Zone	Forti-Fe	Water Volume	Area	Notes
Greens/Tees/ Sports Pitches	20-30 litres	300-600 litres	1 hectare	Protect from freezing
Bowling Greens	3-4.5 litres	45-90 litres	1500m²	

Protect from freezing temperatures. Store containers above 5°C to maintain full actives in solution.

Emerald Iron chelated iron

An exceptional product providing 6% iron all in the form of a DTPA chelate. A genuinely sulphur/sulphate free formulation. Emerald Iron provides a fresher green-up than most ferrous sulphate based products.

The DTPA chelate binds iron exceptionally strongly at pH levels up to 7.8 maximising bioavailability and minimising unwanted reactions in the rootzone.

Emerald Iron contains a superwetting agent to significantly enhance foliar uptake. Emerald Iron is a low scorch formulation.

Benefits and Features

- Good green-up and hardening-off effect
- Sulphur/sulphate free
- Long term bioavailability at soil pH below 7.8
- Strongly chelated iron
- Mild, low scorch formulation

Application

Dilute in water prior to spray application. Apply at 20-30 litres per hectare every 4-6 weeks. May be used year round. Apply to dry turf. Do not apply over frost.

Pack sizes available

5 litre, 20 litre, 200 litre

Zone	Emerald Iron	Water Volume	Area
Greens/Tees	20-30 litres	300-600 litres	1 hectare
Fairways/ Sports Pitches	20 litres	200-600 litres	1 hectare
Bowling Greens	3-4.5 litres	45-90 litres	1500m²

Protect from freezing temperatures. Store containers above 5°C to maintain full actives in solution.

ACTi-Fe

ACTi-Fe is ferric ammonium citrate (FAC) - a moderately well chelated form of iron (citrate being the chelating agent) which has low scorch potential and is good for outfield areas.

FAC is often supplied as a liquid containing significant sulphate levels, however ACTi-Fe is supplied as a cold water soluble powder for high cost effectiveness and contains very little sulphur/sulphate.

Benefits and Features

- Good green-up and hardening-off effect
- 21.5% Fe, 5% nitrogen and less than 0.1% sulphur
- Easy to dissolve even in cold water
- Low scorch
- Chelated iron

Application

Dissolve in water prior to spray application. Apply every 4-6 weeks. May be used year round. Apply to dry turf. Do not apply over frost.

Pack sizes available

25kg and 50kg kegs

Zone	ACTi-Fe	Water Volume	Area
Greens/Tees/ Fairways/ Sports Pitches	4.5-9 kg	300-600 litres	1 hectare
Bowling Greens	680g-1.35kg	45-90 litres	1500m²

Product should be kept dry and in sealed air tight containers (as supplied) when in storage.

Ferrous Sulphate Heptahydrate

Highly cost effective. Damp grade ferrous sulphate heptahydrate provides ~20% iron as supplied. For dilution in water prior to application for green-up and hardening-off.

Benefits and Features

- Highly cost effective iron source
- Greens-up and hardens-off
- Good solubility grade with relatively low impurities

Application

Dissolve in water prior to spray application. Apply every 3-6 weeks as required. Apply to dry turf. Do not apply over frost.

Pack sizes available

25kg bags

Zone	Ferrous Sulphate Heptahydrate	Water Volume	Area
Greens/Tees/ Fairways/ Sports Pitches	5-10 kg	200-600 litres	1 hectare
Bowling Greens	750g-1.5kg	22-90 litres	1500m²
Notes: Over application can lead to scorch and blackening of moss			

Product should be keep dry and part used bags sealed back down to remain air tight when in storage. Ferrous sulphate undergoes slow oxidation in water at pH values above 3 – this generates a fine precipitate over time – this should not block nozzles if spraying is concluded within 4 hours of preparing any solutions.

Girder Liquid iron (19.4% w/v)

A very high iron content liquid coming in at 19.4% Fe w/v (12.5% Fe - w/w) (density 1.55 typical). Iron is provided in ferric form.

Benefits and Features

- Cost effective liquid iron
- Very high iron content for a liquid product
- Greens-up and hardens-off

Application

Dilute in further water prior to spray application. Apply every 3-6 weeks as required. Apply to dry turf. Do not apply over frost.

Availability:

5 litre, 20 litre, 200 litre, and IBCs filled to 500-1000 litre

Zone	Girder	Water Volume	Area
Greens, Tees, Sports Pitches	5-10 litres	300-600 litres	1 hectare
Bowling Greens	750ml - 1.5 litres	45-90 litres	1500m^2

Protect from freezing temperature. Store containers above 8°C to maintain full actives in solution. Girder is acidic and may 'fume'. Care must be taken in its handling - refer to safety data sheet.

A mix of Forti-Fe, Liquid Turf Hardener and Molasses provides us great plant colour and health to withstand the rigours of elite professional rugby. We also use Hydrozone to improve our moisture management throughout the summer and Intensive Wetter has worked well for us in the winter.

Ed Mowe

Head Groundsman

Leicester Tigers Rugby Club

GBR Liquid Turf Hardener

A foliar turf hardener based on cations with double charges (calcium and magnesium), designed to strengthen cell walls. The product is acidified to aid tank mix compatibility and assist in minimising leaf disease. Nitrate based to aid rapid uptake of the cations.

Benefits and Features

- Designed to assist disease suppression in turf grass
- Rapid uptake
- Acidified
- May be tank mixed (speak to us about compatibility)
- For year round application

Application

Apply monthly while the plant is still active. The product should be diluted in water prior to spray application as per the chart.

Pack sizes available

10 litre, 200 litre

Zone	GBR Liquid Turf Hardener	Water Volume	Area
Greens/Tees/ Fairways/ Sports Pitches	20 litres	300-600 litres	1 hectare
Bowling Greens	3 litres	45-90 litres	1500m²

Calcium and its role in turf hardening

Calcium is one of the six macronutrient elements required for the turf plant and can sometimes be overlooked, particularly on sand based greens. Leaves of most turf grasses may contain from 0.5% to 1.25% calcium based on the dried tissue and is similar in concentration to phosphorus. When leaf growth is rapid, calcium concentration can decline in the tissue.

Calcium plays an important part in cell wall synthesis and has a role in stabilising developing cell walls.

The double charge on a calcium ion (and magnesium) can link pectate chains together giving rigidity to new cell walls and may form the basis on which polysaccharides establish the structure of the primary cell wall. Sometimes more than 50% of a plants calcium will be present in the cell wall and this binding by the calcium ion contributes towards cell rigidity. Disease pathogens often initiate their infection of a plant by producing enzymes that degrade the cell wall. Calcium pectate is resistant to one of these key enzymes and adequate calcium in the cell wall can render the plant largely resistant to many pathogen attacks.

Abundant calcium levels may also protect plants from high salt (sodium chloride) levels. Adequate calcium may also make plants more tolerant of many biological and physical stresses.

Spreadable Turf Hardeners

Turf Hardener

A turf hardener designed to aid hardening and create long lasting green-up. Its high potassium content helps stress relief and maintains plant count. The iron content is a combination of high analysis natural granular iron with readily available and slow release iron sources and iron sulphate. Contains trace elements and humic acids to assist improved root development.

2.5-0-10 + 9% Slow Release Iron.

Benefits and Features

- High potassium content to help stress relief
- Helps to achieve hardening and provide long lasting green-up
- Can improve root development
- Designed for use in autumn and winter months

Application

To be applied to greens (1.5mm/150 SGN) during the autumn and winter months.

Pack sizes available

20kg and 25kg bag

Zone	Turf Hardener	Area
Greens	35-50g	m^2
	350-500kg	1 hectare

Cold Start Granular Iron

To be used in the spring months, Cold Start Granular Iron aids hardening, creates green-up and helps spring growth. The potassium nitrate content aids stress relief and maintains plant count. Ammonium sulphate is also included providing further nitrogen that is readily available to the plant in cold temperatures.

10-0-10 + 8.9% Slow release iron.

Benefits and Features

- Helps with spring growth
- Aids hardening and creates green-up
- Helps stress relief

Application

To be applied to golf greens, fairways and sports pitches (1.5mm/150 SGN) during spring months.

Pack sizes available

20kg and 25kg bag

Zone	Cold Start Granular Iron	Area
Greens, Fairways, Sports Pitches	35-50g	m^2
	350-500kg	1 hectare

Since Peter has visited, he and GBR have revolutionised the way in which I purchase products. Myself and my team feel that the range on offer is of a high standard and comes at a very competitive price. More importantly, the way that the products are specifically promoted by Peter to my needs and not his, I personally find very refreshing. He takes the time to understand the route I choose with regards to the products I use and not just advertise products that he wishes to sell. Peter is always happy to provide advice whenever we discuss arising problems and concerns out on the course. I also feel it is a great testament to Peter that the team enjoy his visits for a chance to bounce ideas around with him, as all too often, reps can visit with a sense of duty rather than enjoyment. It is of no surprise that because of this the majority of my products are purchased with GBR.

Paddy Hetherington

Head Greenkeeper

Ponteland Golf Club

Granular Spreadable Iron

100% Ferrous sulphate granular hardener also containing magnesium designed to treat golf greens, fairways and sports pitches. Can be used as an alternative to liquid iron to create green-up and harden turf, reducing disease.

0-0-0 + 12% Iron 5% MgO.

Benefits and Features

- Creates green-up
- Hardens turf
- Reduces disease

Application

Apply directly to turf to treat greens (1.5mm/150 SGN) or fairways (2-4mm). If applied at higher than recommended dosages this product will cause blackening and burn moss. Use 35-40g/m^2 between September – early March or as a one off treat at any time of year to increase colour.

Zone	Granular Spreadable Iron	Area
Greens, Fairways, Sports Pitches	35-40g	m^2
	350-400kg	1 hectare

Pack sizes available

20kg and 25kg bag

... our
Grass Seed Range

Introduction

We offer a complete range of grass seed mixes for all sports. We promote the full range from Hurrells Specialist Seeds, an established and well respected blender of excellent quality grass seeds well known at many leading sports venues across the UK. Additionally we supply the Masterline range from DLF Seeds. Products are shipped speedily direct from manufacturer.

Hurrells are based in Yorkshire and in recent years have maintained their exceptionally strong regional presence whilst increasing their coverage nation-wide. As an independent they can source from a range of the top breeders and offer the highest quality, competitive pricing and speedy delivery. They offer a wide spectrum of cultivars from many breeders worldwide, all recommended by the STRI or the British Society of Plant Breeders.
Being independent, Hurrells have freedom to maximise cultivars.

Back in 2010 Hurrells doubled their warehouse space and dedicated a sector to amenity straights and mixtures. They are expanding again as their long established business continues to grow – a testament to the quality and level of service they provide.

In addition to the grades listed below for golf, there is also a wide range available for football, rugby, cricket, bowls and other sports. Product descriptions are correct at time of going to print.

Seed mixture specifications for greens

HG.1 Premium Greens - 100% Bent	
Sowing rate : 8g/m²	HG.1 Premium All Bent Greens - 100% Premium Bent mixture. Very high shoot density. Good disease tolerance. Great all year round colour. Tolerant to very close mowing. Excellent for over sowing throughout the year for renovation work. It is also perfect for new green constructions. It will tolerate very low cutting regimes for fast, even and superior greens.
Overseeding: 5g/m²	

HG.2 Greens – Creeping Bent	
Sowing rate : 8g/m²	HG.2 All Creeping Bent Grass Seed has the highest shoot density and tillering capacity compared with other bent grass types. Includes the highly rated creeping bent. Great disease tolerance and excellent all year round colour. Recommend low nitrogen applications to prevent thatch previously associated with older creeping bent cultivators. Exceptionally tolerant to very low cutting heights and temperature extremes.
Overseeding: 5g/m²	

HG.3 Greens – Fescue/Bent	
Sowing rate: 35-70g/m²	HG.3 Fescue / Bent- very popular traditional ultra-fine Fescue / Bent Grass Seed Mixture. The mix for new green constructions and it can also be used to oversow greens for renovation work. It will tolerate very low cutting regimes for fast, even and superior greens. Excellent all year round greens turf quality. The cultivars used are very high quality.
Overseeding: 20-35g/m²	

HMG Greens – Fescue/Bent	
Sowing rate: 35-70g/m²	Traditional Chewings/ Bent Grass Seed mixture. Extremely fine and dense sward. Can be cut low. Very popular for new green sowings. Great for over sowing. Great quality. Competitive price. Can also be used on a Bowling Greens and other fine areas.
Overseeding: 20-35g/m²	

HPG Turf Greens – Perennial Ryegrass	
Sowing rate: 35-70g/m²	A new mixture of a Dwarf Perennial Ryegrass mixture for Golf Greens. Sowing to mowing in bare areas in 9 days (in ideal conditions). Low mowing height as low as 4mm. Performance tested to improve greens that struggle using traditional Fescue & Bent Grass. Easy to establish in most soils, very quick to grow. Through testing preferred cultivars very fine leaf turf type perennials. Excellent dark green colour –very healthy natural appearance. High shoot density and playing characteristics. In our trials Non crowning varieties for a smooth ball roll. Excellent wear tolerance and highly competitive nature. Cheaper alternative to Bent & Fescue.
Overseeding: 25-35g/m²	

Grass Seed Range

Seed mixture specifications for fairways

HF. 1 Fairways – No Ryegrass

Sowing Rate: 35-70g/m²	HF.1 Non Ryegrass Fairways - A premium fairway grass seed mixture without rye. Good visual merit due to fine leafed varieties. It takes slightly longer to establish than the rye grass option but requires less cutting than a rye grass option and gives a finer finish for perfect playing surface. Good all year round colour. Can be used for new sowings or re-seeding renovations on the fairways. Very good drought tolerance and great disease resistance.
Overseeding: 20-35g/m²	

HF. 2 Fairways – With Ryegrass

Sowing Rate: 35-70g/m²	HF.2 Ryegrass Fairways – a premium fairway grass seed mixture with Ryegrass. A very fast establishing grass seed mixture for new sowings or renovations on the fairways and other areas including tees and semi-roughs. The best mix for high traffic areas and quick re-growth from wear and tear. It can also be used for filling in divots. Good visual merit due to the fine leafed grass varieties. Extremely quick to germinate. Ultra-hard wearing.
Overseeding: 20-35g/m²	

Seed mixture specifications for tees

HT. 1 Tees – 100% Rye Grass

Sowing Rate: 35-70g/m²	Grass seed mix for Golf Tees. The ryegrass in this mixture will enable a rapid fast establishment. Excellent wear tolerance. Very good shoot recovery. Excellent disease resistance. Can be used for new Golf tees, over sowings and patching up divots. Includes endophyte which makes the plant stronger. Good all year round colour.
Overseeding: 20-35g/m²	

HT. 2 Tees – No Rye Grass

Sowing Rate: 35-70g/m²	Grass seed mix for Golf Tees with no rye. Fine leafed that will give a very attractive looking Golf Tee. Can be cut low. Excellent disease resistance. Can be used for new Golf tees, over sowings and patching up divots. Good all year round colour. High rated cultivars.
Overseeding: 20-35g/m²	

Grass Seed Range

Low temperature germination specification

Coldstart 100	
New sowings: 35-70g/m^2	Coldstart Grass Seed - This particular grass seed mixture grows in soil temperatures down to at least 5 degrees. (Other perennial ryegrasses require at least 8-12 degrees to grow). It's also extremely fast growing, drought tolerant and has a high resistance to disease. High wear tolerance. A perennial mix that will last forever. Ideal for autumn or early spring renovations.
Overseeding: 20-35g/m^2	

Specifications for miscellaneous mixtures

HR. 1 – Roughs	
Sowing Rate: 35-70g/m^2	Fescue grass seed mix for Golf Roughs. Designed to make rough areas easy to manage (Doesn't require much cutting). Providing a natural looking area. Allows balls to be visible when players are looking in there. The grass shouldn't grab the Golf club too much when playing out of the rough (unlike course leafed quick growing plants that make it very difficult for the golfer).
Overseeding: 20-35g/m^2	

HM Fescue	
Sowing Rate: 35-70g/m^2	HM. Fescue – 100% Fescue Grass Seed mix provides a good resistance to disease, as well as exceptional shoot density and a tolerance to low cutting. It will work in low fertility soils. Fescues are pH tolerant and naturally adapted for use on the golf course. Mainly used for fairways and green surrounds but can be used for most other areas for that perfect finish where rye isn't required.
Overseeding: 20-35g/m^2	

HM Tri-Fescue	
Sowing Rate: 35-70g/m^2	HM. Tri-Fescue - The Tri-fescue grass seed mix groups the fescue family together to produce an extremely fine mix. It has the advantages of all 3 grass's - good disease tolerance, high drought resistance, good speed of establishment, very clean cut, good shade tolerance and very high shoot density. Suitable for tees, fairways and green surrounds. Adapted for areas that may be sandy or suffer drought conditions.
Overseeding: 20-35g/m^2	

HM.5 Shade	
Sowing Rate: 35-70g/m^2	HM.5 Shade – The market leading mix for shady areas due to the ingredients within the mix. Can also tolerate damp/wet areas. Will grow in a wide range of soil types. Very high quality and fine leafed. Can also be used in non-shady areas. Grows in a wide range of soils – optimum pH is 5-7 – requires a firm fine seedbed and soil temperatures of 10+ degrees.
Overseeding: 20-35g/m^2	

HM Drought Tolerant (Rhizomatous Tall Fescue)	
Sowing Rate: 35 – 70g/m^2	Grass Seed mix that is ideal for Drought prone soils that are very free draining. Perfect for warm /summer sports usage and challenging summer wear areas. Excellent in sandy soils for example any areas that may have bunker splash were performance in such areas is excellent. Turf type tall fescue has a lower watering requirement. Very competent rooting system develops quickly allowing turf/plant survival even in very dry conditions.
Overseeding: 20 – 35g/m^2	

The Basics of Plant Biology

The Basics of Plant Biology

With a bewildering amount of knowledge coming at us from the industry and it's suppliers, it's not a bad idea to remember from time to time, the basics of the how plants function. In this article we look at some of the basics of plant biology found on many GCSE syllabuses

Photosynthesis:

Fundamental to plants of course is photosynthesis.

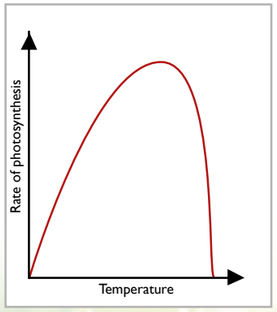
The basic equation is:

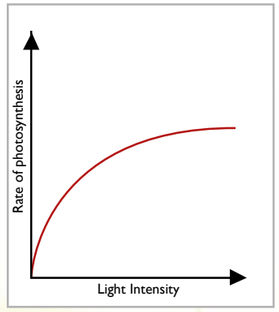
Carbon dioxide + water (+ sunlight + chlorophyll) → glucose + oxygen

Glucose is used for respiration (plants also respire) but is also largely converted to starch as energy storage (for later conversion back to glucose).

There are three factors that affect the rate of photosynthesis. They are light intensity, temperature and carbon dioxide concentration. As we move from winter to spring light intensity increases and daylight lengthens and temperatures increase.

The graphs below show how the rate of photosynthesis change with increasing light intensity and temperature. Notice that for temperature there is a peak and when the leaf temperature starts to exceed 37°C then the rate of photosynthesis starts to drop.



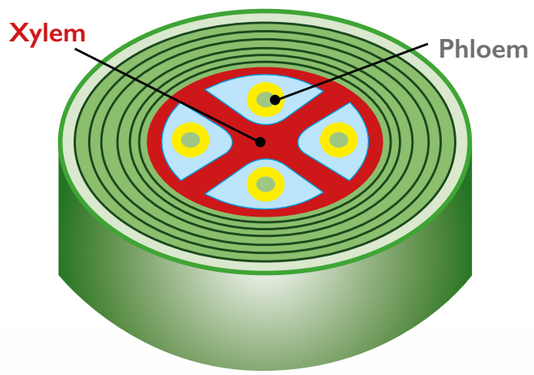


Leaf Structure:

The leaf is designed for effective photosynthesis, it needs to:

- Be efficient at absorbing light
- Be able to exchange gases (carbon dioxide and oxygen)
- Be able to transport water up to the leaf and glucose to other parts of the plant

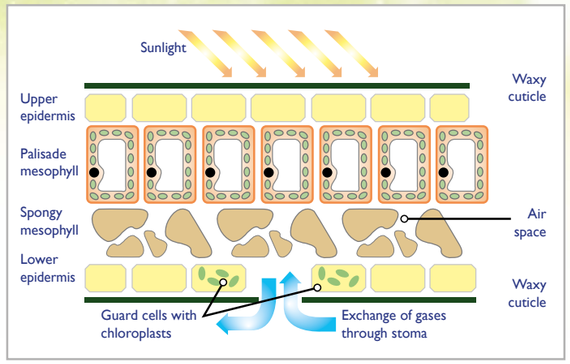
The xylem tissues take water to the leaf from the roots, whilst the phloem transports glucose away from the leaf. These tissues can be found in the plant in the form of vascular bundles as illustrated below:



Gas Exchange:

It's the mesophyll cells where gas exchange happens. Mesophyll cells form spongy tissue – they are loosely packed and covered by a thin layer of water. Stomata are the small pores leading to the mesophyll cells and through which carbon dioxide and oxygen diffuse. The stomata can open and close to control the loss of water (by transpiration) from the leaf. The stomata are located on the underside of the leaf. The top of the leaf is coated with a thin wax cuticle that protects the leaf without cutting out any sunlight.

The below schematic represents a cross section of a leaf:



The palisade mesophyll cells contain many chloroplasts (chloroplast within cells are where photosynthesis occur) and are packed close together.

Absorption of Mineral Ions

Minerals are required by plants for healthy growth. They are absorbed through the roots by a process called 'active transport' (not osmosis) as mineral ions dissolved in soil water. Active transport is a process that requires energy.

Nitrogen is absorbed in the form of nitrate or ammonium ions – plants need sufficient for healthy growth to produce amino acids. Insufficient nitrogen leads to stunted growth. Magnesium is also required for healthy growth – this mineral is found in chlorophyll and a deficiency results in yellowing leaves (chlorosis).

It has also been discovered that minerals can be absorbed by plant leaves (foliar feeding). Minerals in solution applied in this way can get taken up through the stomata and epidermis (with a spray enhancer) and can elicit a rapid response.

Over-use of fertilisers can cause problems within the plant but also eutrophication happens when excess nitrate or phosphate enters rivers or lakes from the land and this can harm aquatic animals.

DLF Seeds – Masterline

Mixture (20kg unless otherwise stated)	Application
PM 5 Economy Green	Golf & bowling greens
PM 10 Traditional Green 10kg & 20kg	Golf & bowling greens
PM 13 Fescue Green	High quality greens, tees & fairways – fescue overseeding
PM 15 Allbent 10kg	Greens renovation mixture
PM 20 Fineturf	Tees, fairways and high quality fine lawns (without ryegrass)
PM 25 Gro-Slow	Low maintenance/poor soils/embankments/golf rough
PM 25R Gro-Slow Plus	Low maintenance/poor soils/embankments
PM 26 Ecosward	Low maintenance landscape mix with clover
PM 27 Ecosward Plus	Low maintenance landscape mix with clover including ryegrass
PM 28 Wetland	Damp and waterlogged soils
PM 29 All Season	Drought tolerance
PM 35 Universal	Cricket squares, tees and tennis courts
PM 36 Wicket 10kg & 20kg	Cricket wicket, tennis and tees renovation
PM 40 Tee & Fairway	Tees, fairways and cricket outfields (without ryegrass)
PM 45 Tee & Fairway Plus	Tees, fairways, cricket outfields and driving ranges (with ryegrass)
PM 50 Quality Lawn 10kg & 20kg	High quality hard wearing lawn
PM 50 Nitro Quality Lawn 10kg	High quality hard wearing lawn (ProNitro coated)
PM 51 Greenscape 5kg, 10kg & 20kg	Hard wearing lawns (with ryegrass)
PM 52 Greenfine 5kg, 10kg & 20kg	Fine lawns (without ryegrass)
PM 60 Greenshade 5kg, 10kg & 20kg	Shaded conditions (without ryegrass)
PM 65 Gallop	Race courses and polo grounds
PM 70 Recreation	Sports fields, tees and fairways and hard wearing landscape turf
PM 75 Stadia	Sports arenas and heavy duty wear
PM 79 Playingfield	Sports filed renovation
PM 80 Renovator	Sports field renovation
PM 80 Nitro Renovator	Sports field renovation (ProNitro coated)
PM 81 Premier Renovation	Sports field renovation
PM 82 Microclover Sport	Sports & playing fields, reduced input costs
PM 90 Coastal	Coastal sites
PM 95 with Rye	Land reclamation infertile, drought. Acid to alkaline
PM 105 Fertility	Fertility building mix
PM 120 Slowgrowth	Landscape, parkland & play areas

... our
Soil Conditioner Range

Introduction

We have a range of soil conditioners to achieve results such as improving soil structure, enhancing cation exchange capacity, adjusting pH and reducing the negative effects of sodium and bicarbonates in the profile.

Liqui-CaT

Calcium thiosulphate is a clear soluble liquid soil amendment containing 6% calcium and 10% thiosulfate sulphur that reduces the negative effects of sodium and bicarbonates in the profile.

Benefits and Features

- Releases locked up calcium
- Flocculates clay particles
- Improves filtration
- Reduces ammonia loss
- Allows potassium, magnesium, iron and manganese to be available to the plant

Application

Apply as a soil drench and irrigate after application to remove product from the leaf. Apply at 20-40L/Ha, or 3-6 litres/m^2.

Pack sizes available

10 litre

Seaweed Meal – 100% Ascophyllum nodosum

For the enhancement of soil structure, seaweed meal powder supplies over 60 trace elements, promotes healthy growth, increases soil fertility, reduces leaching, improves stress resistance and is a source of organic carbon. It is very effective as an ingredient with sand or soil as a top dressing, is ideal for use in golf green construction and as a base for turf laying.

Benefits and Features

- Promotes healthy growth
- Improves stress resistance
- Increase soil fertility
- A source of organic carbon

Application

Use 35-70g/m^2

Pack sizes available

20kg (1-2mm)

Endew Plus has made a significant difference to our greens through the autumn and winter period. When we initially started using it, we left half the chipping green untreated as a control. The difference was obvious and we knew it was a great product. Endew Plus helps us maintain the highest possible condition of the turf throughout the autumn and winter. Combined with our other practices, our greens are more resistant to disease, healthy and have reduced morning dew to ensure a drier cut and less mess on the surfaces.

Leigh Powell

Course Manager

Windlesham Golf Club

Granular Lime

Fine turf (greens grade) spreadable granular lime for adjusting pH in amenity turf or any other soils that require modification of pH.

Benefits and Features

- Spreadable granular
- Adjusts pH in turf and soils

Pack sizes available

20kg (2-3mm), 25kg (2-4mm)

Application

	Sand & Loamy Sands	Sand Loams & Silt Loam	Clay Loam & Clay	Organic Soils (20-25% OM)	Peat Soils (>25%OM)
Grams required to raise pH by 0.5 (e.g. 5 up to 5.5)	28	43	57	72	100
Grams required to raise pH by 1 (e.g. 5 up to 6)	56	86	114	144	200

Zeolites

Natural mined products with unique physical, chemical and cationic exchange properties. This product also contains a full range of trace elements. High based sand rootzones offer little capacity for water and nutrient retention, plus when sand gets compacted it can hold too much water, retarding growth.

Zeolites increase cation exchange and re-mineralise poor soil; they reduce fertiliser leaching and chemical run off and prevent water logging to harden-off playing surfaces.

Benefits and Features

- Increase cation exchange
- Re-mineralise poor soil
- Reduces fertiliser leaching and chemical run off
- Prevent water logging

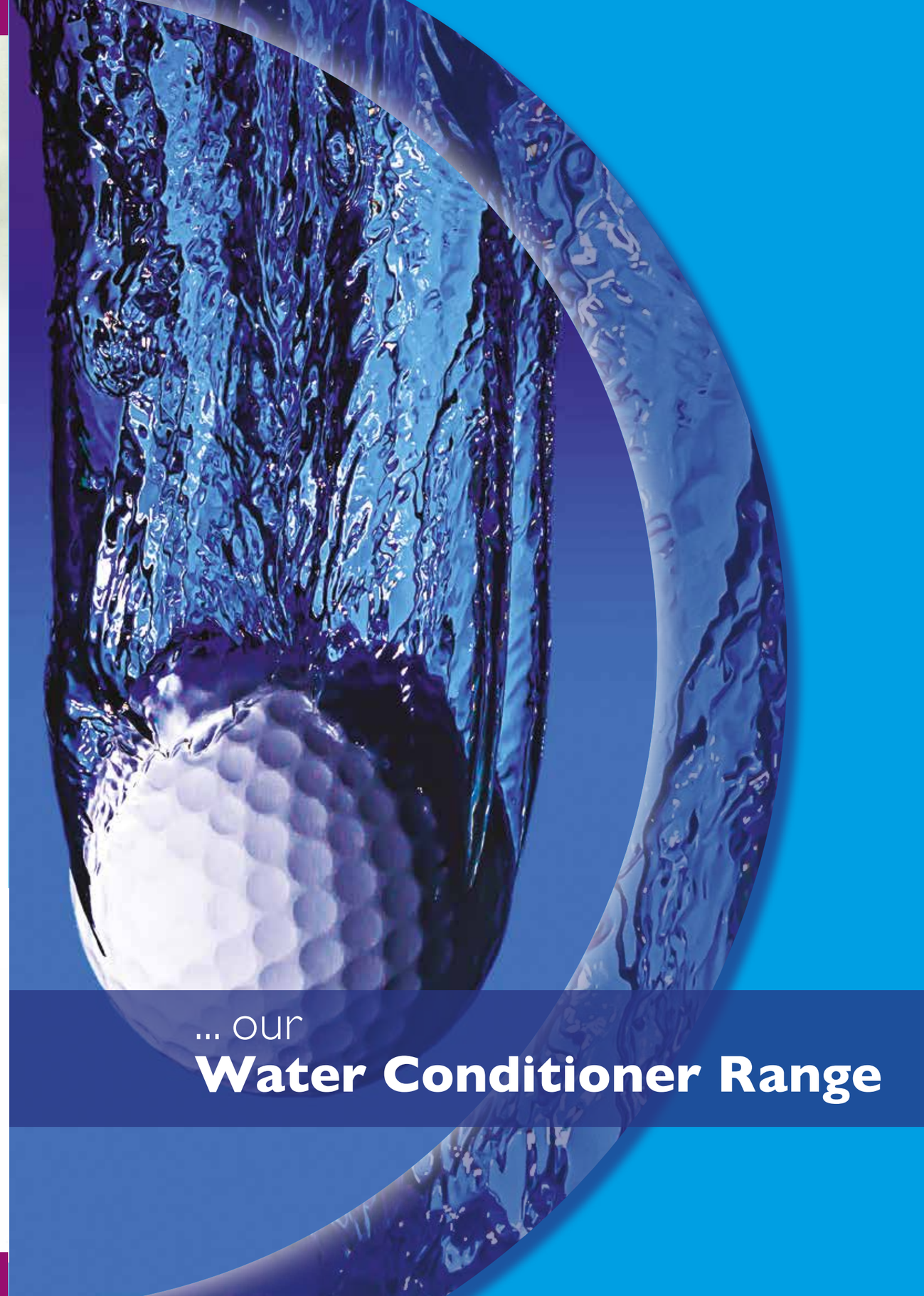
Application

Increase cation exchange (maintenance only): 0.5-1 tonne/Ha.

Increase cation exchange, harden-off playing surface, prevent water logging (new construction): 5-10 tonne/Ha. Apply after aeration, brushing or drag matting to make sure granular enters rootzone. Can be applied at any time of year.

Pack sizes available

20kg bags



... our
Water Conditioner Range

Introduction

We have a range of water conditioners to adjust pH and chelate, assisting the performance and compatibility of spray tank mixing, and additionally having positive effects in the profile.

GBR Chelator & Acidifier

A citric acid based spray tank additive that can bring a range of benefits to turf as well as a spray tank aid.

Benefits and Features

- Lowers pH
- Chelates metal nutrients
- Can be used to improve tank mix compatibility for some spray tank mixes

Application

Apply as required year round for acidifying and chelating tank mixes or year round every month for aiding reduction of soil pH.

Pack sizes available

10 litre

Zone	GBR Chelator & Acidifier	Water Volume	Area	Notes
Greens/Tees/ Fairways/Sports Pitches	20 litres	600 litres	1 hectare	Rate for soil acidification
Greens/Tees/ Fairways/Sports Pitches	200ml-5 litres	600 litres		Rate for spray tank acidification & chelation. Measure pH to reach required level. Do not acidify spray mixes containing siloxane surfactants below pH 5
Bowling Greens	1.5-3 litres	90 litres	1500m²	

GBR HPC – (High Power Chelator)

A non-toxic, eco-sensitive product which provides superior chelating power that can enable more varied convenience tank mixes and release locked-up nutrients particularly metals - iron, zinc and copper.

Benefits and Features

- Releases locked-up nutrients
- Excellent chelating power
- Non-acidifying

Application

Add to tank first at 5-20 litres per 450-600L of spray mix. Always jar test the product combination.

Pack sizes available

10 litre

Zone	GBR HPC High Power Chelator	Water Volume	Area	Notes
Greens/Tees/ Fairways/Sports Pitches	5-20 litres	600 litres	1 hectare	Use rate depends upon application. To improve tank mix compatibility the rate will have to be determined. To aid remobilisation of locked-up metal irons in root zones 5 litres/Ha monthly is a typical use rate.
Bowling Greens	750ml-3 litres	90 litres	1500m²	

Fielder pHixer (pH adjuster)

For lowering pH in spray tank mixes. Contains citric acid and propionic acid. Certain chemicals require an acid pH for maximum effectiveness and many plant nutrients and micro-nutrients will have an optimal uptake in the slightly acidic range. In addition, regular slight acidification of turf grass sprays (where compatible) can help ensure pH is kept below the higher pHs that are favoured for the development of many turf grass fungal diseases.

Benefits and Features

- Concentrated formulation
- Useful for spray out at the correct pH
- General use of acidified sprays can assist disease suppression at certain times of the year

Application

Use rate depends upon pH required. Typical use rate 100-250ml per 100 litres spray tank solution.

Pack sizes available

5 litre

... our **Turf Colourant and Spray Aid Range**

Pinger

Pinger - liquid (0.8-1.2L/Ha) A superior dark green turf colourant for use to enhance visual appearance for weeks. Can also be used as a divot sand colourant. Typical use rate 0.8-1.2L/Ha. Product is designed for dilution for spray application.

Benefits and Features

- Excellent UV resistance and weather fastness
- Highly concentrated formulation
- Provides high definition contrast on stressed or damaged turf
- Suitable for use on professional sports fields where turf contact occurs
- Achieve attractive and enhanced turf colour
- Can be widely tank mixed
- Can be tank mixed with some foliar fertilisers and other actives

Application Information

Follow label advice. Experiment with use rate range to get preferred strength of colour.

Availability

1 litre, 4.3 litre

We've been using Formulation 42 at Craigielaw since April 2021 and have been really impressed with the results. It's given great uniformity across the greens with surfaces being kept moist but firm with the bulk of the moisture being held in the rootzone. Even in the hottest days over the summer the turf has remained stress free. We will continue to use it over the winter and throughout 2022.

Paul Hay
Head Greenkeeper
Craigielaw Golf Club

GBR Spray Pattern Blue

A well respected and well used product due to its very high strength and cost effectiveness in-use.

Use of GBR Spray Pattern Blue provides a clearly visible, but temporary indication of spray coverage, highlighting missed areas, overlap, or blocked nozzles.

The formulation will fade in sunlight and be readily removed by rain or irrigation water.

Benefits and Features

- Clear indication of where the spray has been applied
- Reduces waste from spray overlap
- Indicates missed areas, drift, leakages and blocked nozzles
- High colour strength – amongst the most concentrated liquid formulations on the market
- Temporary – fades in sunlight and washes out with rain or irrigation

Application

Suitable for use with all standard spray equipment. Temporary staining is possible on skin and clothing - wear gloves and/ or overalls and other necessary personal protective equipment.

Pack sizes available

1 litre, 5 litre, 20 litre

Zone	Spray Pattern Blue	Water Volume	Notes
All turf	75m-125ml	Per 100 litres	Rate of use depends upon colour of grass, speed setting of spray equipment and personal preference

Turf Colourant and Spray Aid Range

GBR Foam Bout Marker

A concentrated anionic foam bout marker.

Benefits and Features

- Produces a stable foam blob for demarcation of treated areas
- Foam will dissipate safely without damaging turf
- Highly concentrated - one bottle will last a long time!

Pack sizes available

500ml, 4 litre

GBR Defoamer

A silicone defoaming agent that can be added prior to and during tank mixing and can also be sprayed onto foam for rapid 'knock-down'.

Benefits and Features

- Foam control
- Rapid foam knock down
- Effective at extremely low concentrations
- Supplied in 1 litre bottles with trigger spray

Pack sizes available

1 litre bottles (trigger spray included)

We have been using Aquazone wetting agent on our tees and fairways over the last 6 years. We apply the Aquazone at 50 litres a hectare twice a year and it definitely keeps the dry patch away. We also use Influxer on some isolated areas in extremely dry occasions if these areas become hydrophobic

Stewart Duff
Course Manager
Gullane Golf Club

... our
Plant Protection Range

Plant Protection Range

Introduction

GBR Technology employ a number of staff with BASIS Certificates in Crop Protection (Amenity Horticulture Turf) and can advise on and supply a number of plant protection products.

Legislation can mean that certain actives are withdrawn from the market and this may affect a number of products. The product listing here is correct to the best of our knowledge at the time of preparing this Product Guide but may be subject to change. Manufacturers product labels should be adhered to and GBR Technology except no liability for inaccuracies in any of the information presented below.

Herbicides

Enforcer (MAPP No. 17274) - A translocated selective herbicide allows uptake through both leaves and roots to control annual and perennial weeds including buttercup, white clover, common chickweed, creeping thistle, groundsel, plantains, ragwort.

Contains:
70g/L 2,4-D, 70g/L MCPA, 42g/L Mecoprop-P and 20g/L Dicamba.

Application:
Use at 7.5 litres/Ha

Pack sizes available:
5 litre

Label Pictograms & Hazard Phrases:

H319 - Causes serious eye irritation
H410 - Very toxic to aquatic life with long lasting effects

Depitox 500 (MAPP No. 17597) - A selective herbicide for the control of many tough broad-leaved weeds (including ragwort) in amenity and agricultural grassland. It is most effective on docks, thistles, nettles, rush and ragwort. It is widely used as a mixer product as it is more effective this way.

Contains:
500g/L 2,4-D

Application:
Use at 3.3 litres/Ha

Pack sizes available:
10 litre

Label Pictograms & Hazard Phrases:

H302 - Harmful if swallowed.
H318 - Causes serious eye damage.
H410 - Very toxic to aquatic life with long lasting effects.

Turfmaster (MAPP No. 16344) - Especially effective on broad-leaved weeds such as buttercup, clover, dandelion, daisy, thistle and plantains.

Contains:
256.25g/L MCPA, 237.5g/L Mecoprop-P and 31.25g/L Dicamba

Application:
Use at 5 litres/Ha

Pack sizes available:
10 litre

Label Pictograms & Hazard Phrases:

H318 - Causes serious eye damage
H411 - Toxic to aquatic life with long lasting effects.

Gallup Hi-Aktiv (MAPP No. 17681) - A total herbicide for the control of annual, perennial and broad-leaved weeds.

Contains:
490g/L Glyphosate

Application:
Use at 1.5-5 litres/Ha

Pack sizes available:
1.5-5 litre

Pro Shield (MAPP No. 17525) - A long-lasting non-selective herbicide for the control of a wide range of annual and perennial broad-leaved weeds and grasses. This post-emergence weed killer is ideal for use on permeable surfaces such as soil, gravel and hardcore.

Contains:
250g/L glyphosate and 40g/L diflufenican

Application:
Use at 4.5 litres/Ha

Pack sizes available:
5 litre

Label Pictograms & Hazard Phrases:

H411 - Toxic to aquatic life with long lasting effects.
EUH208 - Contains (1,2-Benzisothiazolin-3-one). May produce an allergic reaction.

Paradise (MAPP No. 16829) - Is a long-lasting total weed killer which, when used at the correct rate, will control most annual and perennial weeds for up to 6 months. For best results mix Paradise® with a glyphosate-based product such as Gallup Hi-Aktiv. This will kill the weeds which are present at application and also lay a residual barrier which will prevent any future germination and leave the treated area weed free for an extended period of time.

Contains:
25% Flazasulfuron

Application:
Use at 150g/Ha

Pack sizes available:
50g, 150g

Label Pictograms & Hazard Phrases:

H410 Very toxic to aquatic life with long lasting effects.

MMC Pro (MAPP No. HSE7824) - MMC-Pro moss killer is a dynamic combination anti-viral/anti-bacterial disinfectant, fungicide/algaecide and detergent. It kills mould, algae and moss in typically 2-4 days. MMC Pro is suitable for use on all exterior hard surfaces including drives, roofs, paths, tennis courts, artificial turf, concrete, tarmac & block paving.

Contains:
Biocide

Application:
Variable

Pack sizes available:
5 litre

Label Pictograms & Hazard Phrases:

H315 - Causes skin irritation.
H318 - Causes serious eye damage.
H400 - Very toxic to aquatic life.
H412 - Harmful to aquatic life with long lasting effects.

Fungicides

Heritage Maxx (MAPP No. 18246) - A high performance fungicide. The easy-to-use Maxx liquid formulation gives faster uptake, longer lasting disease control and improved turf quality. Treats a variety of turf diseases including fusarium, take-all, brown patch, leaf spot, rust disease and anthracnose.

Contains:
125g/L Fludioxonil

Application:
Use at 3 litres/Ha

Pack sizes available:
3 litre

Label Pictograms & Hazard Phrases:

H302 Harmful if swallowed.
H360Df May damage the unborn child. Suspected of damaging fertility.
H410 Very toxic to aquatic life with long lasting effects

Fungicides cont.

***Medallion TL* (MAPP No. 15287)** - Broad spectrum fungicide approved for the control of fusarium patch, leaf spot and anthracnose.

Contains:

125g/L Fludioxonil

Application:

Use at 3 litres/Ha

Pack sizes available:

3 litre

Label Pictograms & Hazard Phrases:

H410 - Very toxic to aquatic life with long lasting effects.

***Instrata Elite* (MAPP No. 17976)** - A broad spectrum foliar fungicide with both contact and systemic properties for control of fusarium patch, dollar spot, brown patch and moderate control of anthracnose.

Contains:

80.3g/L Difenoconazole,
80.3 g/L Fludioxonil

Application:

Use at 3 litres/Ha

Pack sizes available:

250ml, 3 litre

Label Pictograms & Hazard Phrases:

H400 - Very toxic to aquatic life.

H410 - Very toxic to aquatic life with long lasting effects.

***Plazma* (MAPP No. 19416)** - A powerful, high-performance, broad-spectrum fungicide for the control of disease in managed amenity turf. Azoxystrobin is known to target a wide variety of turf diseases including fusarium patch, take-all patch, brown patch, leaf sport, rust diseases, fairy rings and anthracnose. Plazma has systemic control of wide range of turf diseases, with protectant action. It is ideal in high humidity conditions such as stadiums to prevent the spread of dollar spot.

Contains:

250g/L Azoxystrobin

Application:

Use at 1L/Ha

Pack sizes available:

1 litre

Label Pictograms & Hazard Phrases:

H410 - Very toxic to aquatic life with long lasting effects.

Pesticides

***Sven* (MAPP No. 14023)** - Insecticide for grassland, managed amenity turf, ornamental vegetation and other cereal & vegetable crops. Suitable for aphid control and also soil larvae in grassland and turf.

Contains:

25g/L Esfenvalerate

Application:

Use at 300ml/Ha

Pack sizes available:

1 litre

Label Pictograms & Hazard Phrases:

H226: Flammable liquid and vapour

H302: Harmful if swallowed

H304: May be fatal if swallowed and enters airways

H332: Harmful if inhaled.

H318: Causes serious eye damage

H317: May cause an allergic skin reaction

H373: May cause damage to organs through prolonged or repeated exposure

H400: Very toxic to aquatic life

H410: Very toxic to aquatic life with long lasting effects.

Use plant protection products safely.
Always read the label and product information before use.

... our
Cleaning Range

GBR Winter Ball Wash Fluid

Formulated with a non-toxic anti-freeze, cleaning surfactants, foam control agent, stabilisers and a corrosion inhibitor. For use at 10-30% in water to give cleaning and prevent wash stations from freezing.

Pack sizes available

5 litre,10 litre, 20 litre

GBR Spray Tank Cleaner

A fully formulated aqueous alkaline cleaner for removal of pesticide and other residues from spray tanks. Contains biodegradable surfactants and corrosion inhibitors.

Benefits and Features

- Strong alkaline cleaner
- Compatible with most metals, plastics and painted surfaces
- Low foam
- Versatile - can be used in various applications and hard or soft water

Application

Flood wash in spray tanks by dissolving in water. Use concentration 0.5-5% depending upon requirements. Can be used at ambient temperature up to 60°C (where suitable). Warm water will give superior cleaning results.

Pack sizes available

1 litre, 4 litre

STOKO Kresto® Handwash

Special hand cleanser for the removal of stubborn dyestuffs containing scrubbing-agent Astopon® refined walnut shell powder.

Pack sizes available

250ml tube

... our

Lubricant and Grease Range

Introduction - Lubricants

GBR Technology have been supplying lubricant oils and greases since 1993. We can supply a wide range of products and brands as well as our own branded oils. We are fully authorised and supported distributors to a number of oil manufacturers including oil major and specialist lubricant manufacturers. A selection of the most relevant products are shown in this guide but please do speak to us if you have other requirements. We particularly recommend Petro-Canada products as representing the highest quality end of the market on mineral oils and greases (and they have some surprisingly well priced greases) but also offer quality grades with a stronger price focus.

Lubricant Base Oils

Mineral oils used in lubricants and greases are formulated with various additives to confer various properties. Additives may include anti-oxidants, extreme pressure additives, corrosion inhibitors, dispersants and a number of other additives as required for the product to perform its function and meet the performance requirements of a number of specifications and standards.

Although the additives play a vital role in the performance of the lubricant, so too does the type and quality of the base oil and for any product type e.g. hydraulic fluid, the base oil type will relate most strongly to longevity and quality and also price.

Base oils have been classified by the American Petroleum Institute (API) into 5 internationally recognised base oil groups. Hydrocarbon mineral oils, produced from refining of crude oil fit into Groups I, II and III. Whilst synthetic fluids made from poly alpha olefins (PAO) comprise Group IV. All other base oil types, be it esters, silicones, poly alkylene glycols (PAGS), fluorinated materials etc. fit into Group V.

A word of caution - the term semi-synthetic can be very misleading when applied to base oils in the UK. It may refer to a Group III highly refined base oil – or a combination of synthetic PAO base oil (Group IV) with a lower group base oil. It could be possible to argue that a product is semi-synthetic if it contains 1% PAO in combination with 99% of a Group I base oil – this would be a relatively low quality product but calling it semi-synthetic would convey a high quality image. Most suppliers would be responsible when they describe a product as semi-synthetic but it could be an important point to ask your supplier what they mean by semi-synthetic and get an answer that satisfied yourself since different semi-synthetics can have a very wide difference in the overall base oil quality.

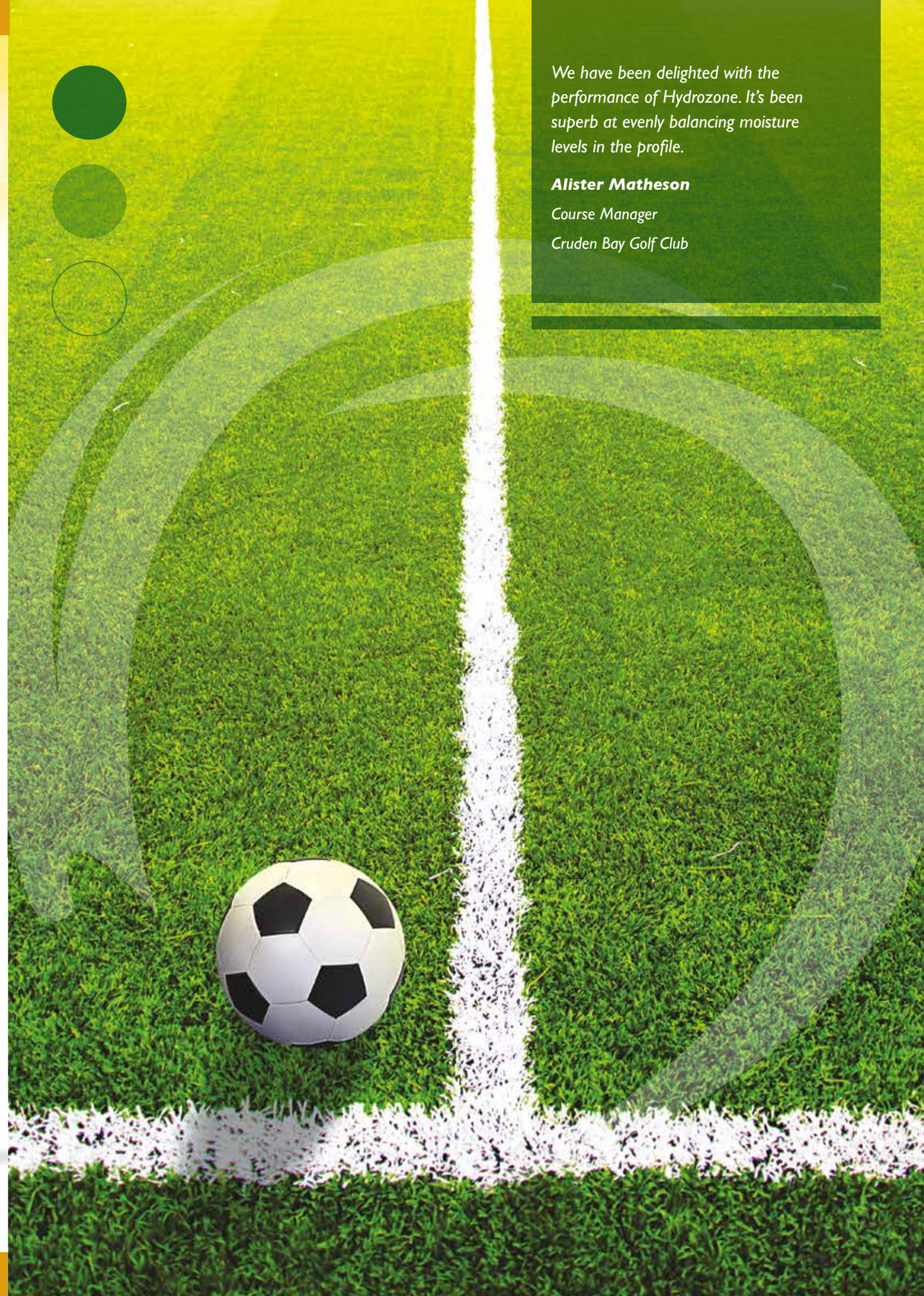
Recycled oils may also be used on occasion. Recycling oil can involve re-distillation or other processes including filtration. Re-distillation would generally give a higher quality recycled oil but may have a sharper odour from the additional heating step on already used oil. Recycled oils are very cheap of course and some lubricants will contain a % of recycled oil as standard.

We have been delighted with the performance of Hydrozone. It's been superb at evenly balancing moisture levels in the profile.

Alister Matheson

Course Manager

Cruden Bay Golf Club



Lubricant and Grease Range

Let's look at Groups I, II and III which are the mineral oils that have been refined to different levels:

Group I: These use a solvent refining process where some of the aromatic and chemically unsaturated components of the oil have been removed. The process is a solvent wash and a significant amount of unsaturated material and some sulphur compounds are left in the base oil. The oil will have an appreciable colour and odour. The oil will have a relatively low viscosity index. The viscosity index is a measure of how much the base oil viscosity will change with temperature - a low VI means a bigger change in viscosity with temperature. High VI is desirable since the lubricant properties will change less over a wider temperature range, for example, think of an engine oil that needs to perform on start up in winter when it might be very cold and then that same oil performing well when the engine is up to its normal running temperature. With the exception of recycled oils, these are the cheapest base oils on the market.

Group II: These base oils typically get the unsaturates content down further by using a hydrotreating process. This chemically reacts some of the unsaturated materials with hydrogen and turns them into saturated materials. The base oils have less odour, less colour, less unsaturates, less sulphur and higher viscosity index. It's important to note that the unsaturated material in base oil is more reactive than the saturated material – over time, especially at high temperature, it will oxidise and the oil will become acidic and begin to break down and this can affect viscosity and form varnishes and sludge – this can further lead to corrosion and a drop off in performance.

Group III: These base oils may use additional steps to clean up the oil. Petro-Canada use processes including hydro-isomerisation to reduce the unsaturates and iso-dewaxing, the latter being a chemical process to render liquid some of the waxy material present in the oil and so benefit low temperature performance. An additional claimed benefit to highly refined base oil is better response from the additives used with them.

Products based on more refined base oils are more expensive than those based on solvent refining alone but they have superior properties. Refined products will give better equipment protection and longer service life, in many cases these cost benefits more than cover the extra cost. An oil that runs for twice as long but only costing 50% more will be cheaper on oil costs - but that's far from the whole story – if you consider lower replacement filter costs, less maintenance, better protection and longer machinery lifetime then the benefits can be very significant. It's a shame however, that in the majority of cases the decision is taken to go with the cheapest base oil due to the lower price. Generally however across industry and transport, Group II base oils are now produced and used in the largest volume – this is a large shift from even a number of years ago when Group I base oils predominated.

In order to see some of the benefits of the more refined products then maintenance schedules would need to be lengthened, this may go against the manufacturers recommendations and would almost certainly invalidate warranties during the warranty period. Sticking to the same maintenance schedule may still give the benefit of better machinery protection but the cost benefit wont be so compelling and this may be one of the key reasons behind the choices made in some cases.

If we look beyond Group III to Group IV we enter the category of poly alpha olefin products. These materials are essentially synthetic hydrocarbons made from ethylene (which is then polymerised to make longer chain materials) and have very good properties but at significantly higher prices. Group V fluids being any chemistries that are not in the other four groups cannot be said to be superior – they are just different. Some of the chemistries have exceptional properties whilst some might be inferior in other aspects to the fluids in the other groups.

Biodegradable Oils

Biodegradable oils are normally esters as natural plant oils e.g. rapeseed oil or synthetic esters derived from plant material. However other chemistries and materials can be used in biodegradable lubricants.

Biodegradability is normally determined for lubricants in relation to an OECD 301B test (modified sturm test). This laboratory test exposes the material under test to a bacterial inoculum and measures carbon dioxide evolution. A material is classified as readily biodegradable if at least 60% of the theoretical carbon dioxide that could be released by its biodegradation is released within 28 days under the test conditions.

API Base Oil Categories

	Base oil Category	Sulphur(%)		Saturates (%)	Viscosity Index
Mineral	**Group I (solvent refined)**	>0.03	and/or	<90	80 to 120
	Group II (hydrotreated)	<0.03	and	>90	80 to 120
	Group III (hydrocracked)	<0.03	and	>90	>120
Synthetic	**Group IV**	PAO Synthetic Lubricants			
	Group V	All other base oils not included in Group I, II, III or IV			

Introduction - Greases

Greases provide lubrication through release of the base oil that makes up the largest component of the product. A thickener is used to turn the base oil into a grease and the amount of thickener used can be varied to give the grease its 'stiffness'. The 'stiffness' of a grease is defined by its penetration value and fits into an NLGI category. Most greases are made to NLGI grade 2 which gives a soft butter consistency – to achieve this state around 10-30% of the grease may be thickener. The type of thickener plays a key role in the temperature range the grease can operate to and its water resistance. Lithium complex greases are widely used on grease points and bearings on grass cutting equipment however they do not have the water resistance of calcium sulphonate thickened greases and the latter offer advantages for machinery used out of doors.

A complex grease is made using two or more carboxylic acids (as opposed to one) – this imparts a good high temperature characteristic to the product. As an example, you could source a lithium soap grease or a lithium complex grease – the former would be slightly cheaper whilst the latter would be superior at higher temperature.

Petro-Canada Products

Petro-Canada produce an exceptional range of high quality lubricants, many incorporating their highly refined water white 99.9% pure base oils which derive from their patented HT Purity Process. This process produces exceptional quality Group II and Group III base oils which give long service life, higher viscosity index and lower toxicity products.
Petro-Canada are also the worlds number 1 producer of food grade white oil and are thus used to making oils of the highest purity.

PETRO-CANADA

ACTi-Fe gives excellent green up, mixes in the tank with all my other products and is very cost effective. The 50kg tub is much easier to use, store and dispose of than an IBC, barrel or lots of smaller liquid containers.

Michael Cartwright
Head Greenkeeper
Highcliffe Castle Golf Club

Lubricant and Grease Range

Below is a list of some of the products we offer into the amenity market – detailed technical data sheets are available on request. Please do speak to us if you have other requirements as we do supply a very much wider range.

Engine Oils

Petro-Canada – Duron HP 15W-40

A very high quality, all round engine oil with good start up and very good particulate dispersing abilities – can demonstrate extended drain intervals on equipment outside of warranty – reducing oil and servicing costs. Choose Duron HP 15W-40 for dependable year round use in the UK.

Pack sizes available:
20 litre pail, 205 litre steel drum

Petro-Canada – Two Cycle Motor Oil

A quality lubricant designed to give excellent performance in air-cooled, two-stroke cycle engines.

Pack sizes available:
20 litre, 205 litre

GBR Technology 10W40 Semi-Synthetic

An E6/E9 heavy duty oil offering high levels of protection and cleanliness under severe operating conditions and extended drain capabilities. Meets Euro IV, V, and VI emission standards.

Pack sizes available:
20 litre, 205 litre

GBR Technology 15W40

An E3 multigrade engine oil which meets the majority of the latest engine manufacturer's requirements and specifications.

Pack sizes available:
20 litre, 205 litre

GBR Technology 10W30 SUTO

A premium quality multi-grade SUTO oil giving high performance in agricultural tractor engines, transmissions and hydraulic systems.

Pack sizes available:
20 litre, 205 litre

GBR Technology 15W30 SUTO

A premium quality multi-grade SUTO oil giving high performance in agricultural tractor engines, transmissions and hydraulic systems.

Pack sizes available:
20 litre, 205 litre

Hydraulic & Transmission Fluids

Petro-Canada – Duratran

Meets a wide variety of manufacturer's specifications including J20C.

Pack sizes available:
20 litre, 205 litre

Petro-Canada – Duratran Synthetic

Meets a wide variety of manufacturer's specifications including J20C and J20D.

Pack sizes available:
20 litre, 205

Petro-Canada – Hydrex AW 46

A very high performance anti-wear hydraulic oil developed for high pressure hydraulic systems operating under moderate to severe conditions.

Pack sizes available:
20 litre, 205 litre

Petro-Canada – Hydrex AW 68

A very high performance anti-wear hydraulic oil developed for high pressure hydraulic systems operating under moderate to severe conditions.

Pack sizes available:
20 litre, 205 litre

GBR Technology ISO 46 Hydraulic Fluid

Full anti-wear hydraulic fluid that incorporates performance improvement additives to offer great anti-wear characteristics, oxidation resistance and corrosion protection.

Pack sizes available:
20 litre, 205 litre

GBR Technology ISO 68 Hydraulic Fluid

Full anti-wear hydraulic fluid that incorporates performance improvement additives to offer great anti-wear characteristics, oxidation resistance and corrosion protection.

Pack sizes available:
20 litre, 205 litre

GBR Technology ISO 46 Bio Hydraulic Fluid

A high blend of naturally occurring esters and ashless, antiwear, anti-oxidant, anti-foam and anti-corrosion additives. To be used in systems where biodegradable fluids are preferred for environmental reasons.

Pack sizes available:
20 litre, 205 litre

GBR Technology ISO 68 Bio Hydraulic Fluid

A high blend of naturally occurring esters and ashless, antiwear, anti-oxidant, anti-foam and anti-corrosion additives. To be used in systems where biodegradable fluids are preferred for environmental reasons.

Pack sizes available:
20 litre, 205 litre

Gear Oils

Petro-Canada – Traxon 85W-140

A multi-grade gear oil formulated for use in high temperature operating conditions, where a GL-5 SAE 140 oil is called for, to provide excellent long-lasting wear protection to extend equipment life and reduce downtime and maintenance costs.

Pack sizes available:
20 litre, 205 litre

Chainsaw Oils

Petro-Canada – Duratac 150

High quality chain saw oil – ISO 150 viscosity. For lubricating chains, guide bars, journal bearings and sprockets of modern high speed chain saws. Formulated to reduce dripping and "throw off".

Pack sizes available:
4x4 litre, 20 litre

Greases

Petro-Canada – Precision XL EP 2

A very high quality NLGI Grade 2 lithium complex grease for a wide range of general applications. This grease is based on Petro-Canada's 99.9% pure base oil. You won't beat this standard lithium complex grease on quality or price!

Pack sizes available:
400 gr cart, 17 kg pail

Petro-Canada – Peerless OG 2

Based on a special type of calcium sulphonate complex thickener; these greases are highly effective in the presence of water. They are capable of absorbing moderate levels of water without softening or changing consistency, whilst still providing outstanding rust protection. OG 2 is NLGI Grade 2 grease with excellent adhesion.

Pack sizes available:
400 gr cart, 17 kg pail

Petro-Canada grease kegs come with a removable plastic liner – meaning the empties can be disposed of as uncontaminated metal waste.

GBR Lithium EP2 Grease

A specially developed multi-purpose lithium complex grease for lubricating all anti-friction and plain bearings for use in industrial, agricultural and automotive applications.

Pack sizes available:
12.5kg pail

Maintenance Sprays

PX-24 Industrial Maintenance Spray

Industrial MIL spec PX-24 stops the spread of existing corrosion, gives lasting protection against further attack, removes and repels ambient moisture, quickly free seized nuts, bolts and bearings, and can be used for light surface rust removal. Product is supplied 100% active so volume cannot be compared with an aerosol pack which contains mostly propellent.

Pack sizes available:
500ml trigger pack, 5 litre can

Specialist Lubricants Krytox™ & Perflox

Fluorinated oils and greases with a range of unique properties including resistance to high temperatures, aggressive chemicals, long term resistance to oxidation, very wide elastomer compatibility, extreme resistance to water washout and non-soluble in hydrocarbon fuels. These materials have a static coefficient of friction below their dynamic one (a rare property) which means they are also freakily effective at eliminating squeaks and rattles. These lubricants can be a useful problem solver for a number of applications and will keep performing for a very long time. Use sparingly. Available in small bottles and tubes as well as larger pack sizes.

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