

Turf fertiliser...a question of balance and perspective

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

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

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

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

around the food web and immediately available to grass roots is the complementary and interactive benefit.

Plant nutrition the natural way

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

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



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

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

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



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

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

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

Losing the essentials of plant nutrition

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

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

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

Essential turf grass nutrients

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



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

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



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

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

Nitrogen – the succulent growth and green up nutrient

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

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

Phosphorous – the anchorage element

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

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



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



Potassium – the gatekeeper

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

Calcium – the strongman nutrient

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

Magnesium – the lightning conductor

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

Sulphur – the forgotten nutrient

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

Iron – the lean and mean green-up nutrient

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

Copper, zinc and manganese – the enzyme co-factors

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

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



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

is a co-factor for the enzyme polyphenol oxidase.

Boron – the meristem minder

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

Molybdenum – the metabolism maker

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

By-passing the soil

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

High permeability of sandy soils coupled with a relatively low cation

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

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

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

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

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

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

Fertiliser in balance and perspective

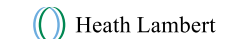
Turf managers should always go as far down the 'fostering the food-web' track as possible, but not rule out the use of rapid remedial action where necessary.

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

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

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

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



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