



Soil Nutrition & The Vital Role of Trace Elements

Martin Lane takes the mystery out of what should be your richest asset - your soil

In the last 20 years or so the science of greenkeeping has become much more demanding as golf has massively increased in popularity. Greenkeepers are now under constant pressure from the golfers to provide perfect, dark green, even playing surfaces -just like Augusta! The snag is that, unlike at Augusta, they can't close the course for six months of every year. To achieve perfection all year round is therefore, rather a tall order in our northern climate.

The density of human traffic and the demand for all-year-round course availability has led to a revolution in course design and maintenance. The increase in popularity of sand-based greens has been due partly to American influence and partly to this need to provide all-year playing conditions. All golfers appreciate the excellent playability of these surfaces throughout the seasons, as do the clubs as they compete for business.

As always, there is a downside. Trying to grow and maintain fine golf

turf on sand can be complicated, time-consuming and expensive. As a result, a whole industry has grown up offering a myriad of off-the-shelf products all claiming to be the answer to the greenkeepers' prayers, but often just adding to the confusion. As we pour on thatch-reducing agents and microbial inoculates, do we ever ask ourselves how we came to kill off all the native organisms in the first place? As we spray on the fungicides do we wonder why golf courses are now so vulnerable to fungal attack?

The effect of all this has been to distance us from our roots (oh dear!) and allow us to forget that Nature knows a great deal more about growing grass than we do. Our role in life is to assist it, not spit in its face! In recent years it has been all too easy to forget that we are dealing with a sensitive ecosystem that has been around for millions of years. To understand fully the problems generated on our somewhat artificial playing surfaces, we first have to take a close look at normal soil.

Soil is made up of a mixture of rock particles, organic matter and living organisms. In ideal circumstance these exist in symbiotic harmony and this, with the addition of sunlight, rain and the Earth's atmosphere, offers the perfect growing medium for plants. As the constituent rock particles naturally weather, mineral nutrients are released into the soil and are taken

up by plants in a ratio that constitutes their perfect "diet". The plants thrive, are healthy and disease-resistant. The presence and activity of beneficial soil microbes enable this transfer of nutrients from soil to plant

Of course there are many variations on the theme and soils vary enormously from poor to rich, from light to heavy and so on. Climatic variations also have a dominant effect. Even so, soils are the natural growing medium, containing the spectrum of nutrients/elements essential to life and in this case, grass.

NON-MINERAL NUTRIENTS

The non-mineral nutrients are Hydrogen, Oxygen and Carbon. These are found in the air, in water and, if you aerate properly, in the soil. Plants use Carbon dioxide (CO₂) and Water (H₂O) + energy from the sun to make the starches and sugars that are their food. (The word Photosynthesis actually means "made with light"). To grow and thrive, plants also need mineral nutrients. These are divided into two groups, macro-and micro-nutrients and are naturally absorbed through the roots.

MACRO OR MAJOR NUTRIENTS

The primary nutrients are Nitrogen, Phosphorus and Potassium. They are often the first to be lacking, because plants use up significant soil reserves during growth. The second nutrients are Calcium, Magnesium and Sulphur. On golf courses sulphur is rarely deficient, but the others can need attention. Interestingly, the more you balance the micronutrients/trace elements, the less conventional fertiliser you need.

TRACE ELEMENTS /MICRONUTRIENTS

These are only needed in small amounts for plant growth and survival, but are absolutely vital. Of those that directly affect plant growth, the most commonly known are Boron, Copper, Chloride, Iron, Manganese, Molybdenum and Zinc. Others, such as Selenium and Iodine have no direct role in plant growth, but their principle function is to feed the soil microflora, the living organisms without which it is impossible to create an efficient growing medium. (They are also fundamental to animal and human health.)

Sand, like soil, is also made up of rock particles, but unlike natural soil, the particles are larger and coarser and therefore have a much smaller surface area relative to their size. This greatly reduces weathering rates and the release of nutrients, making sand essentially a sterile, highly porous medium, low in organic matter and unable to produce or retain the required, fine balance of nutrients. Because of this, on high sand content areas, plant nutrition has to be supplied by the greenkeeper.

Sadly, the problem is much more complicated than it first appears. There are literally hundreds of NPK fertilisers on the market of varying strengths, ratios and release rates. Most are based on agricultural practice and are designed to replace the predicted loss of only three macronutrients; Nitrogen (N), Phosphorus (P) and Potassium (K). If we try to grow grass on high sand content areas using only NPK nutrition, we will not succeed. As an analogy, it is not unlike trying to raise a child on bread and water alone. There is nothing wrong with bread and water, but the child will sicken and die without a full and balanced diet. This is precisely what happens nowadays to farm animals being raised on poor grass from exhausted fields; they sicken and die without a cocktail of the missing, essential minerals being added to their diet. A further complication arises because to be effective, these mineral nutrients are each needed in widely varying, but very specific concentrations in the soil to mimic Nature. Failure to observe this golden rule results in at best a waste of money and at worst, disaster. This is as true in South East Asia, the Middle East and Europe as it is in the UK

Over-use of NPK is probably the commonest mistake made. Even the best soils can be wrecked, the balance of nutrients destroyed by the injudicious use of chemicals and fertilisers. Here there are more lessons to be learned from agriculture. In order to bolster sagging returns, some

farms are being run more and more intensively to increase yields. This involves increased use of fertiliser as more crops and animals are reared on the land.

After some years of this treatment, yields begin to fall despite the fertiliser and disease afflicts both crops and animals. On investigation, we find that the reserves of crucial Trace Elements or Micronutrients have been stripped out of the soil. This has happened for two reasons; firstly because the excessive fertiliser and chemical use has removed elements such as Selenium and killed off most of the beneficial soil microbes; secondly because intensive cropping has reduced the remaining soil micronutrient reserves below critical levels, hastening the collapse in fertility. We now operate on a knife-edge in the UK, because intensive cultivation, industrial pollution and the excess use of fertiliser and chemicals have reduced the soil mineral reserves by 75% in the last 100 years - no wonder we have problems!

Without all the components of nutrition, grass will never thrive and will always be weak and disease-prone. This is the main reason why new playing surfaces are so prone to diseases such as take-all patch and fusarium in the early years; the plants have no immunity because they are starved of the correct trace elements and the soil balance is all wrong. On problem courses we see fertiliser used to create 'green-up', followed by growth inhibitor to reduce mowing! This is both expensive and unnecessary. When the balance is right the grass is greener, disease-resistant and less in need of fertiliser and pesticide. The healthier the plant, the denser the growth, the longer the growing season and the faster the divots will repair. With minimum use of synthetic Nitrogen, there will also be less watery, weak-celled, vertical growth, needing less cuffing and possibly, less ingress from poa annua.

There are other sound financial and ecological reasons for the carefully metered use of macro- and micronutrients. Financially it makes sense not to waste money on excessive use of any products, but more importantly, it is becoming unacceptable to leach carcinogenic nitrates, phosphates, pesticides and fungicides into the local water supply. Before long it may become a condition of planning consents that leaching be reduced to much lower levels. Prohibitively expensive, fully lined greens with captive drainage systems are becoming compulsory in parts of Europe and the signs are that controls will become much tighter in the UK. It is the strongly held view of the author that tailored, monthly dressings of the precise nutritional requirement of greens, tees and fairways will prevent leaching and thus remove the need for more draconian legislation. The native flora and fauna also gain enormously from this system. As the course returns to a balanced ecosystem, back come the insects, including the pollinating bees; the wild flowers and the birds. The golf course can again be seen as a haven of wildlife, much more acceptable to the community and the local planning authority!

In future, much more thought must be given to the planning stage of course construction and alteration. For example, substantial benefits will accrue from bringing in specialists before the construction of new projects. Then the correct nutrient balance can be accurately calculated and incorporated into the bases of new tees, greens and fairways during construction, whatever medium is being used. This will significantly speed up growth and shorten the lag time between construction and playability, providing more robust playing surfaces quicker. It will also please the accountants, because if it results in an extra six months of revenue at the outset, it will greatly improve the Club's cash flow and bottom line.

Martin Lane is Technical Director of Field Science

Tel: 01980 629444

Fax: 0117 909 2432

Email improve@fieldscience.co.uk