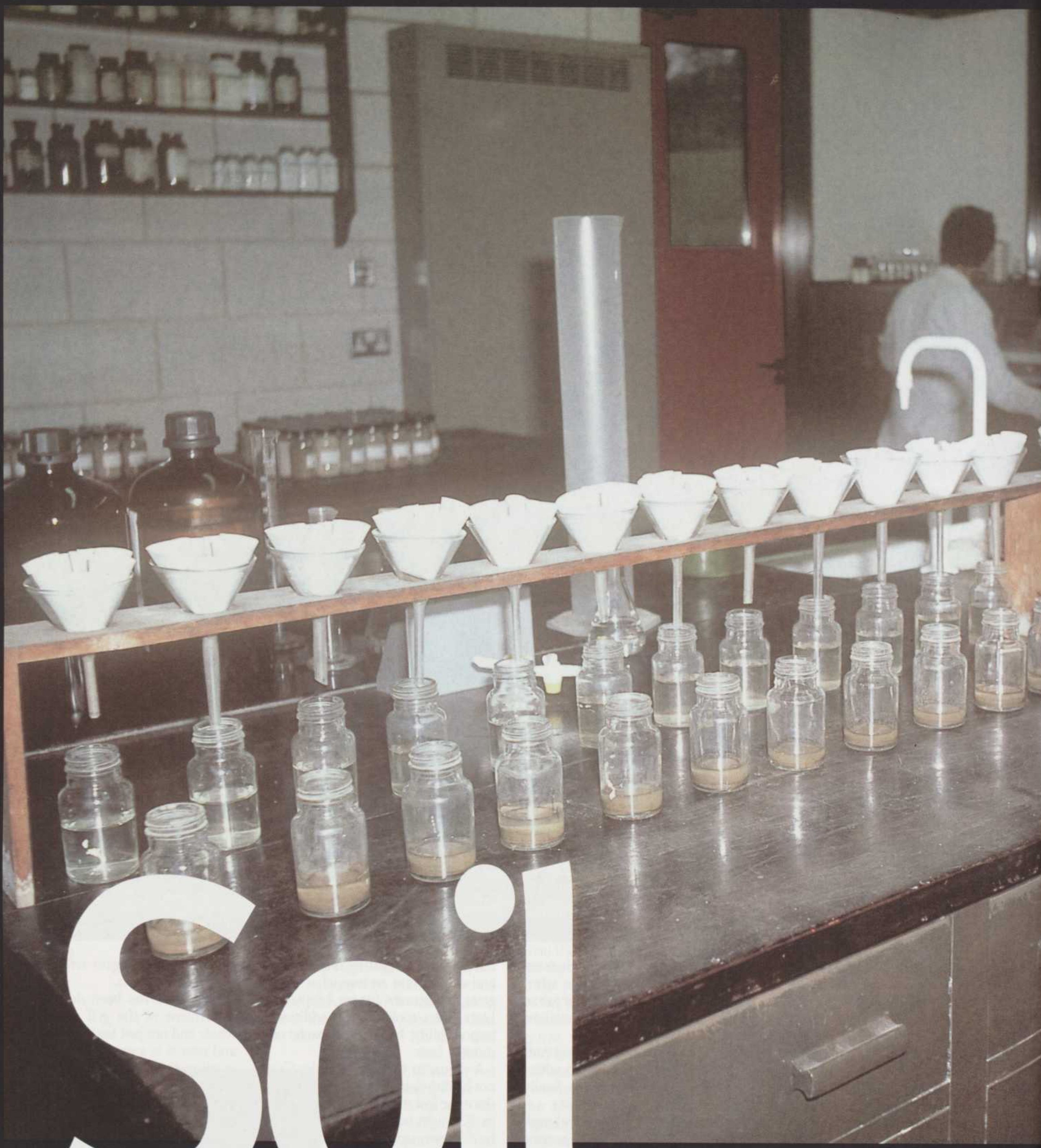

Soil analysis

Unravelling the mystery

Daniel Binns leads you through the confusing path of soil analysis ...

Periodic soil analysis is important in order to review trends of pH and nutrient levels in the soil. There are currently a variety of testing alternatives available to the greenkeeper but few of these are independent. Furthermore the information they provide is often confusing and difficult to understand. The purpose of this article is to help interpret the minefield of information which can often accompany the results of your chemical analysis once it returns from the laboratory.

As far as we know there are 13 essential elements in the soil necessary for plant growth. These are required in addition to three nutrients, which are not derived from the soil but from the atmosphere and water. These are carbon (C), oxygen (0) and hydrogen (H) and form the largest percentage of the plant, on a dry weight basis. The plant carbohydrates are composed of these elements. The only reason we usually don't think of these as being essential nutrients is because we do not have to supply them through fertilisation and they are not derived from the soil.

The 13 soil-derived nutrients are divided up into macronutrients and micronutrients. Macronutrients are

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required in largest quantity and include nitrogen (N), potassium (K), phosphorus (P), calcium (Ca), magnesium (Mg) and sulphur (S). Micronutrients are present in very small quantities within the plant. These trace elements (micronutrients) are chlorine (C1), iron (Fe), manganese (Mn), boron (B), zinc (Zn), copper (Cu) and molybdenum

(Mo). All of these nutrients need to be present in adequate quantities for concentrations are measured in parts per million of leaf material.

Soil pH is, of course, the single most important chemical factor that influences turf management. It is a measure of the acidity or alkalinity of the soil, determined by the concentration of hydrogen ions in a soil solution. Acidic soils (pH below 7.0) have a high concentration of hydrogen ions while alkaline soils (pH above 7.0) have a low concentration of hydrogen ions.

In more acidic soils, certain nutrients become less available, namely nitrogen, phosphorus, calcium, potassium and magnesium. Potentially toxic elements such as aluminium and manganese are made more available through acidification. Many species of grass will not thrive under these conditions and as a consequence soil pH has a significant effect on the species that dominate the turf.

Most of the nutrients that we supply to the turf through fertilisers are positively charged ions. We call these cations. These cations can become attached to the negatively charged surfaces of clay and organic matter in the soil. When cations become attached to these cation exchange sites on clay and organic matter, they become temporarily retained by the soil. These nutrients can then be utilised at a later time by the plant.

There are also negatively charged plant nutrients. These include nitrate-nitrogen, phosphates, sulphates, chloride and molybdenum. Due to the negative charge, they cannot be held by soil clay organic matter and these nutrients tend to move more quickly through the soil along with soil water. Thus they are prone to leaching losses, and once they leach beyond the rootzone of the turfgrass roots, they are no longer available to the plant.

One essential plant nutrient is neutral, meaning it has neither a negative or positive charge. This nutrient is boron in the form or boric acid, but the plant requires it nonetheless, although grasses need much lower amounts than broad leaved plants.

The ability of a soil to retain cation nutrients is important. As the content of clay and organic matter in the soil goes up, so does the soil's cation exchange capacity. Cation Exchange Capacity (CEC) is an indicator of the nutrient holding capability of the soil and can be a useful indicator in its own right. The term refers to the ability of negatively charged soil particles to attract the positively charged ions.

Sands have lower CEC than soils containing clay. It is for this reason we need to make repeated light applications of fertilisers under sandy soil conditions. The nutrients are not retained by sandy soil because it has a very low CEC. However, in heavier or more organic soils we find that the need for nutrients from fertiliser is lower because they typically retain a lot of these cationic nutrients. These nutrients remain in the soil and are available to the plant for a longer period of time.

Although CEC is of interest, it is not the most important factor in determining nutrient holding capacity of soil. It is the amount of organic matter present which determines the quantity of nitrogen and other nutrients held within the soil. For example the organic matter under a golf green has far more of an impact on the turf s fertility rather than CEC It is the organic matter which holds the nitrogen reserves.

The majority of greenkeepers undertake routine soil analyses to monitor nutrient levels on their greens. Regular (perhaps yearly) testing has the greatest value especially on sandy rootzones where changes can occur rapidly. ideally, samples should be submitted from each green on the course. Representative sampling may be appropriate if all the greens are constructed and managed the same way, also helping to keep analysis costs to a minimum. Identifying the best, worst and one average green.

Collect the samples at the same time each year, to the same depth and use the same laboratory - preferably an independent one. this process eliminates a few variables that can compromise the value of the data. Samples should be obtained at least three weeks after any fertiliser application.

Nutrients can be extracted in the laboratory in a number of ways but in sports turf we are now seeing standardisation of these extraction methods. It is the interpretation of the results that often causes confusion.

Commonly soil chemical analysis can be interpreted in two ways. the first is the more proven, traditional method of predicting the quantity of plant available nutrients in the soil. Basing a sound fertiliser programme on pH values and level of available nutrients will provide an accurate assessment of nutrient requirements in the rootzone.

The second method of interpretation uses the base cation saturation ratio.

Recommendations are made by ranking the calculated percent cation saturation with an ideal base saturation taken from research in agriculture. The percentage base saturations are those likely to be found in a soil of neutral pH. They are not necessarily the optimum ratios for plant growth and are simply derived from the natural element concentrations in soil.

As a consequence recommendations from this method assume a pH of 7.0 is desirable because nutrient availability is increased in neutral soils. Unfortunately this fails to recognise that most greenkeepers in the UK aim to have mildly acidic soils where favourable grass species will dominate, disease incidence can be reduced and weed growth inhibited. Having mildly acidic soil may have a detrimental effect on the availability of some nutrients, but it may be this very fact that gives the poverty grasses a competitive edge in a Poa annua dominated world.

As you can imagine this method can often highlight a number of anomalies in the soil, for example copper or boron deficiency. In reality, it is extremely rare to find deficiencies of any of the micronutrients on turf in the UK.

The only way to be sure that any soil test predicts nutrient availability for turf is to carry out the basic research. Interpretation of analysis results must be based on trials with turf grasses growing under varying nutrient regimes such that deficiency symptoms are actually induced.

There are now a plethora of greenkeeping products available on the market and we are constantly bombarded with information on the latest development that will make all the difference to our turf. In terms of nutrition, try not to be blinded by science; instead keep resistant, disease tolerant turf are the physical maintenance of the rootzone and sensible nitrogen fertiliser applications.

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