AN INTERPRETATION OF THE SOIL ANALYSIS REPORT

Introduction

The soil report is divided into 5 sections:

1. Texture
2. Standard Soil Analysis
3. Macro-Nutrients
4. Computed Base Saturation
5. Trace Nutrients

The following points explain these sections in more detail.

1. TEXTURE

- Soil is divided into its three main mineral fractions of:

  (a) Sand (poor nutrient retention)
  (b) Silt (moderate nutrient retention)
  (c) Clay (very good nutrient retention)

- All soils contain varying fractions of sand, silt and clay.
- An ideal soil would contain approximately equal portions of these three fractions to form a loam.

2. STANDARD SOIL ANALYSIS

This follows the ADAS method of evaluating soils (College method in Scotland) which provides a measure of the "available" major nutrient content for plant growth.
The "available" major nutrient content is obtained by extracting the nutrient with a solvent. Results are then expressed in terms of an index which is presented over a range of 0 to 9.

(a) Phosphorus

- Target index for grazed grass is 2.
- Target index for ensiled grass is 3.

(b) Potassium

- Target index for grazed grass is 2.
- Target index for ensiled grass is 3.

(c) Magnesium

- Target index for both grazed and ensiled grass is 2.

3.MACRO-NUTRIENTS

This section of the analysis report covers biological criteria including:

(a) Organic Matter – This is made of dead or composted biological matter and is an important nutrient reserve, particularly for soil microbiology and fauna, including earthworms. It is also important in improving soil water retention capability.

- Target Organic Matter range is 5-7%.

(b) Microbial CO_2 Burst Test – This is a measure of aerobic bacterial activity in soils. These are the "good" bugs which breakdown organic matter soil reserves to release nutrients for plant uptake. The soil sample is dried to shut down the bacteria. Samples are then moistened to "wake up" the bacteria and sealed for 24hours. The "waking up" of the bacteria triggers a "burst" or flush of CO_2. The magnitude of this burst is measured in the lab and is proportional to the biomass of aerobic ("good") microbial organisms.

- Target Microbial CO_2 Burst is 30+ although the higher the better.

(c) Sulphate – Sulphur is both an important nutrient for plant growth and a natural fungicide. It is expressed in terms of the extractable sulphate content.

- Target Sulphate level is 40-50mg/l

(d) Total Calcium

(e) Total Phosphorus – As the name suggests, this represents the total concentration of Phosphorus in soils contributed by both inorganic and organic sources. Comparing the transfer of Total P to Extractable P (part of the Standard Soil Test) provides a measure of how ideal the conditions are for soil reserves to be converted into plant available food. Phosphorus release from total reserves is very sensitive to soil pH and the presence of other nutrients.

- Target Total Phosphorus is in the range 500-1000mg/l

4. COMPUTED BASE SATURATION

This section is devoted to an analysis of the key mineral nutrients which influence soil structure, its stability and therefore its ability to store essential nutrients for plant growth.

Cation Exchange Capacity - The relative attachment of key mineral such as Calcium to the surface of soil particles (particularly clay and silts) is measured in terms of "Cation Exchange Capacity" or CEC.

- CEC provides both a measure of the nutrient retentive capacity of soils and also the proportion of these key cation nutrients which are attached to the negatively charged surface of soil particles.

- There is an ideal balance of mineral cations attached to soil particles which determines how "open" soils are to air penetration and the support of "good" aerobic bacteria. Furthermore, CEC balance is related to the stability of soil structure and its ability to withstand compaction from grazing livestock or machinery. As such, it is a different way of expressing soil mineral levels to that presented in the Standard Soil Analysis which is more concerned with the availability of nutrients for plant growth.

- Total Cation Exchange Capacity (CEC) is measured in milli-equivalents per 100g soil and provides an indication of the potential nutrient holding capacity of a soil. Generally the higher the level of clay and/or organic matter, then the greater the CEC value.

- The target CEC level is within the range 10-20m.eq./100g.

- A key measure of CEC balance is the Calcium:Magnesium ratio, remembering that Calcium helps to "open" soils up, while Magnesium tends to "close" soils making them stickier and more prone to compaction.

- The target Ca:Mg ratio on a CEC basis varies dependent on soil texture but is generally within the range 5-7.

- Other key target CEC proportions include:

Calcium	60-70%
Magnesium	10-15%
Potassium	3-5%
Sodium	3-4%
Hydrogen	5-10%
Others (Iron & Aluminium)	4-7%

- Recommendations which emanate from this part of the report relate to actions which can improve CEC balance and thereby improve soil stability leading to improved soil fertility and drainage. Typically the use of lime or gypsum (to supply Calcium) or mag-lime and kieserite (to supply Magnesium) will follow from the CEC analysis.

5. TRACE NUTRIENTS

Essential trace nutrients for both plant growth and animal nutrition are presented in this section.

All trace nutrients are presented in terms of their extractable or "available" concentration. This provides a measure of how much trace nutrient is available for plant growth and an assessment as to whether soil supply is deficient, excessive or reasonably well balanced.

However, it is important to make the point that a poor relationship exists between this chemical extraction of trace nutrients and the concentration

found in plants. This is largely due to the myriad of complex chemical reactions which occur in soils, and the plant's ability to obtain the trace nutrient it requires even from apparently deficient soils. Even so, this part of the report still provides a useful measure of potential trace nutrient deficiencies and excesses which can impact plant health and growth.

- Target values for trace nutrients include:

Iron	75-150mg/l
Molybdenum	0.5-1.0mg/l
Copper	5-7mg/l
Selenium	0.5-0.8mg/l
Zinc	6-8mg/l
Manganese	25-35mg/l
Cobalt	0.75-1.50mg/l
Boron	2-3mg/l

When trace element deficiencies or excesses are identified, then it would be recommended to carry out a forage mineral analysis to establish whether the plant's needs are being met and if the soil imbalances have translated through to the grass, to the detriment of plant or animal health.

The final analytical parameter is **Conductivity**, which is a measure of electrical conductivity within a soil. As soils become more compacted and "wetter", electrical conductivity increases. Conversely, as soils become more "open" or have a high content of sand, then conductivity will fall. Although it is a fairly crude measure of soil balance, its determination usually supports other key analyses.

- Target range for Conductivity is 2160-2310 micro Siemens.

Summary

The Soil Analysis report attempts to comprehensively cover the primary features of soil science including:

1. TEXTURE- Soil composition
2. STANDARD SOILS ANALYSIS- Available plant nutrients + pH
3. MACRO-NUTRIENTS - Soil biological life (fertility)
4. COMPUTED BASE SATURATION - Soil structure supporting soil fertility and nutrient storage and release
5. TRACE NUTRIENTS - provision of essential micro-nutrients for plant health and growth.

Action plans can be developed from the analytical data to improve the various aspects of soil nutrition to the benefit of both plant and animal health and productivity.