The Dirt on Soil Tests

Breaking down your lab soil tests

To manage your land effectively, it's essential to understand the soils you're working with. This involves testing soil to identify its physical, chemical, and biological properties, as well as learning how these characteristics interact. Have you received your soil test back and are unsure of how to determine the results? This factsheet has the basics covered!

pH: $CaCl_2$ vs water

pH (water) and pH ($CaCl_2$) both measure acidity, but pH ($CaCl_2$) is more accurate - like a calibrated lab thermometer vs. a home kit. It's less affected by seasonal salt fluctuations. pH ($CaCl_2$) is generally 0.5-1.2 units lower than pH (water).

EC (Electrical conductivity): The salinity gauge

EC measures salt levels. High salinity stresses plants - the salts in the soil water prevent water uptake causing dehydration.

South Australia has 1.5 million hectares affected by dryland salinity, especially in the Upper South East and Eyre Peninsula.

EC (1:5 water extract) guidelines:

- less than 0.15 dS/m is low risk
- greater than 0.3 dS/m, watch for reduced germination and yield.

Carbon: The soil's currency (C)

Not all carbon is created equal. Think of it as different types of savings accounts:

- Labile carbon: The cash in your wallet -it cycles very quickly, an immediately available energy source for soil microbes.
- Particulate organic matter (POM): Your transaction account - fast-cycling, feeds microbes, improves structure.
- Mineral-associated organic matter (MAOM): Your term deposit or long-term savings account - stable, long-term carbon that builds resilience.
- Total carbon: measures all forms of organic and inorganic carbon (i.e., carbonates). Equal to your total wealth.

The nitrogen story (N)

Nitrogen drives plant growth, but it's also highly leaky - a classic double-edged sword and one of the most difficult nutrients to optimise.

- Total nitrogen is the total N stored in soil (organic and inorganic), where the majority is tied up in organic matter. Much of this N is not immediately available to plants although plants can uptake some forms of organic N (eg. amino acids).
- Mineralisation occurs when microbes convert organic N into ammonium (NH_4^+) and nitrate (NO_3^-) - the forms plants more easily take up.
- Nitrate leaches easily, especially in sandy soils - deep soil testing (to 60–90 cm) is essential in SA's variable rainfall zones.

Sulphur (S)

Plants use the sulphate (SO_4^{2-}) form of S which is mainly released by microbial mineralisation of organic matter - dry and cold conditions limit uptake. Sulphate is highly leachable hence sandy, low-organic-matter soils in SA are prone to deficiency. The MCP method measures immediately available inorganic sulphate whereas the KCl-40 method additionally measures a portion of the organic sulphur pool hence is a more comprehensive measurement.

Potassium (K)

In the plant K regulates water, enzyme activity, and stress tolerance. Sandy soils hold less as it can easily leach while clay soils can hold and store more K.

- Colwell K = estimating the readily available and potentially available K.
- Exchangeable K = what's immediately available - like cash in your pocket.

Chloride (Cl)

Chloride is an essential plant nutrient, but deficiencies are relatively rare, with excess often being a more widespread issue. Most chloride is highly soluble and is mostly found dissolved in soil water. In high rainfall areas with good drainage, chloride leaching may occur.

Navigating the highs and lows of boron (B)

A tricky nutrient to manage where both deficiency and toxicity can be challenging in SA soils.

- Deficiency is most common in horticultural and acidic soils as well as dryland surface soil where it leaches down the profile.
- Toxicity typically lurks in deep subsoil where B then accumulates.

For croppers, boron deficiency can be a challenge during establishment (especially for canola) where B levels are low in the topsoil. Once roots reach subsoil accumulations, toxicity symptoms can appear. Grain analysis is the most reliable indicator.

The banks of phosphorous (P)

PBI is the type of bank account that your nutrient balance is held in and relates to how easy it is to liquidate the balance; low PBI is an everyday transaction account, high PBI is a 'trust fund, bonds or term deposit'.

Low PBI may indicate higher fertiliser efficiencies in the short term as it's more available to plants. Caution to high rainfall areas as low PBI can leach and cause havoc to waterways. High PBI can be caused by high levels of iron and aluminium in acidic soils and calcium in alkaline soils.

DGT is kind of what you have available to spend right now in your 'everyday transaction account'.

Colwell P is what you have in your tied up in other "assets which might be liquidated one day but would require a bit of effort". Colwell P is most accurate on slightly acidic to neutral soils.

Olsen P is used on soils that are mildly acidic to alkaline. If soils have a pH of <5.5, this test may be inaccurate by overestimating plant available P. In the right conditions, this test is the most accurate indicator for plant available P in pastures as well as wheat and some horticultural crops.

Total P includes the above but also includes the locked up P or "assets that your parents/in laws" hold which you might get to see a bit one day in the future; but probably not". This pool can be tapped into via enhancing microbial activity.

Trace elements (DTPA): Tiny but mighty

Trace elements like manganese (Mn), zinc (Zn), copper (Cu) and iron (Fe) are essential for plant growth but this test is recommended to compliment tissue sampling for a more accurate result. Availability of traces are influenced on varying factors including:

- Amount of carbonate present - Mn, Zn, Cu are less available in alkaline and calcareous soils
- Iron deficiency can occur on high pH and calcareous soils. Poor drainage and wet conditions can amplify this
- Soil texture - sandier soils are often inherently low in traces
- Soil moisture - drier conditions can mean less movement of nutrients to plants.

ECEC: The soil's battery size

Effective Cation Exchange Capacity (ECEC) is your soil's nutrient storage potential or its battery size. A small battery means low fertility, needs frequent charging (with fertiliser additions), while a large battery holds nutrients, supports nutrient supply and runs longer without charging.

ECEC guide:

- Less than 5 = very light sand
- 5-10 = sandy loam
- 10-15 = loam
- 15-20 = clay loam
- 25-50+ = clay

Exchangeable cations

Tells you how much Ca, Mg, K, Na are being held on your soil's exchange sites, ready for plant uptake.

Exchangeable acidity: The unwanted guests

This is the amount of acid-forming cations (aluminium and hydrogen) sitting on your CEC. High values mean trouble for plant roots and nutrient availability.

MIR Australian PSA: The texture & leaching risk radar

Soil textures with a low clay content and low cation Exchange Capacity (CEC) are more susceptible to leaching and should be managed by applying smaller quantities of nutrients more frequently.

ESI: Dispersion risk

ESI helps you understand the tug-of-war between salt and sodium and whether your soil is at risk of structural collapse. It divides the EC (salinity) by the ESP (exchangeable sodium percentage) - ESI = EC ÷ ESP

IThankyou to the contributions from Ed Scott, Brett Masters and Joel Williams.

Further information

Further information is available through Landscapes Hills and Fleurieu

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