SOIL & LEAF NUTRIENT ANALYSIS

The first step towards management of the soil nutrient and organic matter resource is to conduct tests that quantify these assets. This enables changes from season to season to be monitored. Soil test information can then be used to optimise the nutrient status of the soil and crops grown through good management practices and application of permitted fertiliser materials as required, giving thought to minimising any environmental impact.

Hill Laboratories has a library of **Crop Guides** which detail soil and leaf sampling instructions, interpretation criteria and some general comments on nutritional problems for more than 80 different crops. Please contact Hill Laboratories for specific crop guides and a sample collection 'kit' (or visit www.hill-laboratories.com).

Nutrient Tests – Soil

The ***Basic Soil Profile*** includes tests conducted on most agricultural or horticultural soils. Reported are pH, phosphorus, potassium, calcium, magnesium, sodium, cation exchange capacity and base saturation data. All nutrients reported are considered to be in plant available forms and compared to desired levels.

Further details on the tests available for soils are available from Hill Laboratories on request.

Soil tests

- **pH –** measures the level of the soil's acidity or alkalinity
- **Phosphorus** – essential element for plants and animals; Olsen P is the standard soil test used in NZ to assess 'plant-available' P
- **Cations (K,Ca,Mg,Na)** – important nutrients for plant and/or animal growth
- **CEC (Cation Exchange Capacity)** – measure of the soils capacity to retain cations and characterises soil type and organic matter content.
- **Sulphate Sulphur** - where sulphur is likely to be lost by leaching i.e. sedimentary soils or if sulphur is not included in the fertiliser programme on a regular basis.
- **Organic Sulphur** - where sulphate sulphur status is low and there is a requirement for more information on soil sulphur status.
- **Total Sulphur** – least variable of soil-S tests and will identify soils with S deficiency
- **Resin Phosphorus** - where RPR or similar slow release P fertilisers have been used.
- **Anion Storage Capacity/Phosphate Retention** - where capital application of P fertiliser is contemplated. The P retention value will influence the required application rate to reach a target level.
- **Organic Matter** - gives an indication of nutrient reserve, soil structure and moisture retention characteristics. Normally on cropping soils or in development situations.
- **Available Nitrogen (Anaerobic Mineralisable N)** - test is designed to estimate N status of cultivated soil (potentially available N)
- **Mineral Nitrogen –** soluble ammonium-N (NH_4-N) and nitrate-N (NO_3-N) measured as immediately plant-available sources of Nitrogen. Used for specific input into crop models as point-in-time soil Nitrogen measure.
- **Total Nitrogen** - used in conjunction with Organic Matter to determine C:N ratio as a measure of biological activity in the soil.
- **Reserve Potassium** - where the soils capacity to provide slow release/long term potassium to pasture or crops, including tree crops is required. Measured as TBK test.
- **Reserve Magnesium** - where the soils capacity to provide slow release/long term magnesium to pasture or crops is required.
- **Aluminium –** indicator of plant toxicity when soil pH low (<pH5.5 for mineral soils)
- **Soluble Salts –** uses electrical conductivity test to indicate potential for salinity issues

- **EDTA/Mehlich3**– trace element tests in soil have limited usefulness, for specific investigations only.
- **Boron –** for specific investigations only, most useful for forage and fruiting crops
- **Soil Totals** – measures total pools of nutrients and are not related to plant-available tests. Total Sulphur (tS) has field-calibration and Total Selenium (tSe) correlates reasonably well with plant/animal Se. May be useful indicators of contaminants e.g. Total Cadmium (tCd) and Total Copper (tCu)

Agriculture			
Pasture	Vine/Tree Crop	Arable/Hort Field Crop	Test/Comments
✓✓	✓	✓	**Sulphate Sulphur** – where sulphur is likely to be lost by leaching i.e. sedimentary soils or if sulphur is not included in the fertiliser programme on a regular basis.
✓	-	✓	**Organic Sulphur** – where sulphate sulphur status is low and there is a requirement for more information on soil sulphur status.
✓✓	✹	✹	**Resin Phosphorus** – where RPR or similar slow release P fertilisers have been used.
✓	✓	✓	**Anion Storage Capacity/Phosphate Retention** – where capital application of P fertiliser is contemplated. The P retention value will influence the required application rate to reach a target level.
✹	✓	✓	**Organic Matter** – gives an indication of nutrient reserve, soil structure and moisture retention characteristics. Normally on cropping soils or in development situations.
-	✓	✓✓	**Available Nitrogen –** test is designed to estimate N status of cultivated soil. (Also known as Anaerobic Mineralisable N)
-	-	✓	**Mineral N –** immediately available NO3-N and NH4-N
✓	✓	✓	**Total Nitrogen** – used in conjunction with Organic Matter to determine C:N ratio as a measure of biological activity in the soil.
✓	✹	✹	**Reserve Potassium** – where the soils capacity to provide slow release/long term potassium to pasture or crops is required.
✹	✹	✹	**Reserve Magnesium** – where the soils capacity to provide slow release/long term magnesium to pasture or crops is required.

✓✓	Recommended	✹	For specific investigations only
✓	Optional	-	Not normally requested

A limitation with soil testing, especially for tree and vine crops is that the soil sample taken is unlikely to represent the entire root zone of the crop. Analysis of plant tissue provides nutritional information without this limitation.

Plant tissue analysis permits a much more reliable assessment of the crop nutrient status than is possible from soil tests alone. One of the main problems associated with soil testing is the lack of calibration of the tests for the wide variety of crops and soil types likely to be encountered. Plant tissue analysis bypasses this and other problems, as the adequacy of nutrient supply is assessed directly from the plant.

Nutrient Tests - Plant Tissue (leaf)

Leaf tests indicate the nutrient status of the plants sampled and this information is complementary to soil test data. The nutritional status of plants is influenced by many factors in addition to the soil nutrient status. These factors include:

- soil pH
- soil moisture status and other environmental conditions
- soil physical structure
- interactions between nutrients
- pest or disease incidence

The ***Basic Plant Profile*** includes major nutrients and trace elements required for the nutrition of a broad range of plants. Reported are nitrogen, phosphorus, potassium, sulphur, calcium, magnesium, sodium, iron, manganese, zinc, copper and boron.

Additional tests of specific relevance:

- Molybdenum - essential for legume and vegetable crops (including brassicas).
- Cobalt and Selenium - essential for livestock, commonly tested in pasture and forage crops.

- Iodine - essential for livestock.
- Chloride – particularly for sensitive plants where salinity is suspected.
- NO3-N – toxic for livestock e.g. some greenfeeds

Agriculture		Horticulture						
Pasture	**Crop**	**Fruit Crop**	**Vege Crop**	**Kiwi fruit**	**Forestry**	**Sports Turf**	**Ornamental Crop**	**Tests/ Comments**
✓ ✓	✓ ✓	✓ ✓	✓ ✓	✓ ✓	✓ ✓	✓ ✓	✓ ✓	**Basic Plant**
✓ ✓	✓	✓	✓	-	-	-	-	**Molybdenum**
✓ ✓	-	-	-	-	-	-	-	**Cobalt**
✓ ✓	-	-	-	-	-	-	-	**Selenium**
✓	-	-	-	-	-	-	-	**Iodine**
*	*	-	*	✓ ✓	-	-	✓	**Chloride**
-	*	-	*	-	-	-	-	**Sulphate-S**
-	-	-	-	-	-	-	-	**Aluminium**
*	*	-	*	-	-	-	-	**Nitrate-N**

✓✓	Recommended	✹	For specific investigations only
✓	Optional	-	Not normally requested

Plant Species

Plant samples should be analysed as a single species when being used to diagnose nutrient deficiencies or toxicities. Plants have differing abilities to extract nutrients from the soil and will have different “normal” ranges.

e.g. for pasture the clover and ryegrass composition will have an effect on boron content as clovers typically contain ~23 mg/kg B whereas ryegrass typically contains ~10 mg/kg B. If the pasture is being tested for animal health purposes however, then the combined species should be tested as a single sample as representative of the animals diet.

Plant Part/Growth Stage

Hill Laboratories' crop guides have specific instructions for what part of the plant to sample and at what growth stage or seasonal date. It is important to adhere to these protocols so that the histogram criteria sourced from reference texts can be applied to help with interpretation.

In general the youngest mature leaf principle applies - immature plants tend to have high concentrations of the more mobile nutrients N, P and K while Ca and B more slowly accumulate as the plant matures (so will appear low against the “normal range” histograms). Sampling at too early or too late in the plant's growth cycle will have an effect on the nutrient levels measured.

The laboratory requests that the analysis request form is completed as completely as possible to aid with using the correct sample type code for growth stage e.g. for cereals whether “late tiller” or “ear emergence”, enabling the most appropriate histogram criteria to be applied.

Contact Details

For further information about any of the above tests please contact our Agriculture client service managers.