



SOIL & LEAF NUTRIENT ANALYSIS

The first step towards management of the soil nutrient and organic matter resources 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 to minimise any environmental impact.

Hill Laboratories has prepared 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'.

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 listed above and other tests available for soils including trace elements are available from Hill Laboratories on request.

* Additional tests

- **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.
- **Mineral Nitrogen** – soluble ammonium-N ($\text{NH}_4\text{-N}$) and nitrate-N ($\text{NO}_3\text{-N}$) 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.
- **Reserve Magnesium** - where the soils capacity to provide slow release/long term magnesium to pasture or crops is required.

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.

* For more information about the additional tests listed above see over the page.

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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 to organic growers are:

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

Additional Soil Tests Available

• Sulphate-Sulphur

This test measures readily available sulphur in the form of dissolved plus adsorbed sulphate. Sulphur testing is important where low sulphur or sulphur-free fertilisers are used, such as high analysis NPK fertilisers. Retention of sulphate-sulphur by the soil is related to its phosphate retention, with high leaching losses of sulphate being associated with low phosphate retention soils. This should also be taken into account when considering sulphur fertiliser options.

Level	Sulphate-Sulphur (µ g/g)
Very Low	< 4
Low	4 - 10
Medium	10 - 20
High	20 - 50
Very High	> 50

• Extractable Organic Sulphur

Most of the soil's sulphur (95%) is in organic forms. This pool of S is in a slow equilibrium with the plant available, inorganic form of S. Being a natural source of S, it is useful to have a means of assessing this component, especially where the sulphate-S test indicates low levels of the readily plant available form. This test measures the readily soluble fraction of the organic S pool.

Level	Extractable Organic Sulphur (µ g/g)
Very Low	< 5
Low	5 - 11
Medium	12 - 20
High	> 20

• Resin P

As with the Olsen P test, the Resin P test also gives an indication of plant available phosphorus in the soil. The Olsen P test is considered to have a poorer correlation with pasture growth than the Resin P test where there is a history of slow release phosphorus fertiliser use (i.e. RPR, PAPR or Longlife Super).

Level	Dairy Soil (µ g/g)	Dry Stock Soil (µ g/g)
Low	< 50	< 40
Medium	50 - 100	40 - 75
High	> 100	> 75

There is also evidence that the Resin P test may have some advantages, particularly when interpreting results from a variety of soil types and pHs. However as interpretation data for the Resin P test is limited, this test is offered as an additional test rather than a replacement for the Olsen P test.

• Anion Storage Capacity/Phosphate Retention

Anion Storage Capacity (ASC, previously known as Phosphate Retention) refers to the phosphorus immobilisation property of the soil. Although high ASC soils may require between two and three times the amount of phosphorus as capital or maintenance fertiliser than low ASC soils, it is important to realise that an ASC of 90% does not mean that 90% of the applied P is rendered unavailable to plants.

Level	ASC/Phosphate Retention (%)
Very Low	< 10
Low	10 - 30
Medium	30 - 60
High	60 - 80
Very High	> 80

ASC should be included with any initial soil test to establish the value for that soil type. This value is an inherent property of the soil and does not change.



TECHNICAL NOTES

- **Organic Matter**

Organic matter in the soil is the main contributor to the soil's C.E.C, and is also a source of many nutrients, especially nitrogen. Soils with medium to high levels would generally be expected to have good structure, moisture retention and water percolation properties. The effectiveness of some agrochemicals is also dependent on soil organic matter.

$$\text{Organic Matter (\%)} = \text{Organic Carbon (\%)} \times 1.72$$

Organic matter is calculated from the organic carbon level. It is also used together with the total nitrogen result to calculate the carbon/nitrogen ratio.

Level	Organic Matter (%)
Very Low	<3
Low	3 - 7
Medium	7 - 17
High	17 - 35
Very High	>35

- **Available Nitrogen (Anaerobic Mineralisable N)**

This test is designed to give an indication of the quantities of nitrogen that could be readily mineralised from soil organic matter under ideal soil conditions. The actual amounts of nitrogen that will mineralise in the field will depend on factors such as soil temperature and moisture, which are impossible to emulate or predict in the laboratory.

Level	Available Nitrogen kg/ha 15cm sample depth
Very Low	<50
Low	50 - 150
Medium	150 - 250
High	250 - 350
Very High	>350

The test measures the long term potential of cultivated soil to provide nitrogen, but is not generally recommended for pasture soils.

- **Total Nitrogen & Carbon:Nitrogen Ratio**

This nitrogen test measures the 'total' nitrogen content of the soil. It includes nitrogen that is unavailable to the plant. The major use of this test is to provide nitrogen levels for the carbon/nitrogen ratio.

Level	Total Nitrogen (%)
Very Low	<0.1
Low	0.1 - 0.2
Medium	0.2 - 0.5
High	0.5 - 1.0
Very High	>1.0

The ratio of organic carbon and total nitrogen gives important information as to the nature of the organic matter present in the soil.

A ratio of 10 - 12 is normal for an arable soil with a good rate of organic matter mineralisation, 15 - 20 indicates slow mineralisation of the organic matter. Ratios greater than 25 suggests that the organic matter is not mineralising.

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- **Reserve Magnesium**

Reserve magnesium is used to estimate long-term magnesium reserves in the soil.

The difference between the slow, long term available magnesium and the exchangeable magnesium of the soil is called the Reserve Magnesium. Slow weathering of magnesium containing minerals and clays can supply an appreciable proportion of plant requirements.

Level	Reserve Magnesium (me/100g)
Very Low	<3
Low	3 - 7
Medium	7 - 15
High	15 - 30
Very High	> 30

- **Reserve Potassium**

The amount of slowly released potassium is often more significant than the amount of immediately available exchangeable potassium. The "Reserve Potassium" test is used to estimate the long term potassium supplying potential of the soil, and appears to be unaffected by short term treatments. An alternative test known as "TBK" (modified from the original Jackson test) has now largely been adopted in NZ laboratories. This test gives similar information about the long-term supply of reserve potassium, but with numerically different interpretive levels.

Level	Reserve Potassium (me/100g)	TBK (me/100g)
Very Low	< 0.10	<0.4
Low	0.10 - 0.20	0.4 – 0.8
Medium	0.20 - 0.35	0.8 – 1.2
High	0.35 - 0.50	1.2 – 1.8
Very High	> 0.50	>1.8

Agriculture		Horticulture		Test/Comments
Pasture	Crop	Tree Crop	Field Crop	
✓✓	✓	✓	✓	Sulphate Sulphur – where sulphur is likely to be lost by leaching ie 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
✱	✱	✱	✱	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