



# Soil and foliage sampling

Soil and foliage analysis is increasingly important for long-term forest health. Nutrient deficiencies can be analysed early to help reduce risk and ensure plants have what they need to grow.





# Soil sampling

## Why sample soil?

Soil analysis is increasingly important for long-term monitoring of forest sustainability, with carbon, nitrogen and phosphorus measurements being of greatest importance. Sampling schemes need to be developed to take into account the large variety of soils across the landscape.

## How to collect soil samples?

1. Soil samples are taken:
  - (a) at a pre-defined plot that is sampled over time to measure change; or
  - (b) to target certain landforms/soil types to monitor a larger variable area.
2. Using a stainless steel tube sampler (Hoffer tube) collect for:
  - (a) a minimum of 30 Hoffer cores
  - (b) 50 Hoffer cores for each area of interest.Avoid small patches not typical of the area. Overlying organic soil layers (litter and humus layers) must be removed before collection of the mineral soil underneath.
3. Typical sample depth is 0-10cm. Deeper sampling (e.g. 10-20cm and 20-30cm) provides more information on nutrients available and is important for monitoring changes over time.
4. Collect a core sample every ~10 metres or at a regular spacing over the whole area until all core samples have been obtained to bulk into one sample bag. You can reduce the size of the soil sample collected by carefully mixing and subsampling prior to sending (500g is a good size sample).

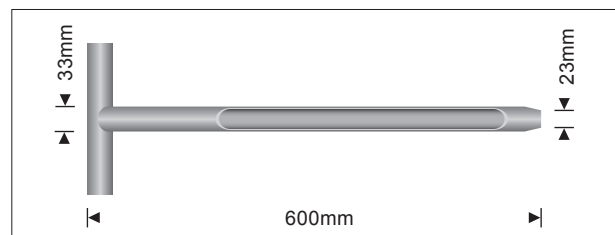
**Note:** Try to sample areas before applying fertiliser and do not sample within 3 months after applying fertiliser. Try to sample areas **before** major land clearing operations such as burning or ploughing.
5. Place the samples in a clean plastic bag.
6. Identify the samples clearly with an ID label inside the bag and labelling on the outside of the bag.
7. Keep samples cool before sending.
8. Package the samples in a strong carton and include all essential information on a **Soil Input Form** (available from [www.scionresearch.com/analytical-services](http://www.scionresearch.com/analytical-services)), or refer to the list of information you should supply with your samples.
9. Clearly mark the package SOIL SAMPLES and send them to Scion within 5 days to the address provided over the page.

## Information to supply with your samples

- your name and date of collection
- the forest/area the soil was collected from
- compartment number or alternative identifier
- trial and workplan numbers if applicable
- species and age or year to be planted
- previous vegetation cover or rotation number
- fertiliser history
- expected weed competition
- depth of sample, e.g. 10cm
- what tests you would like
- any other relevant details.



## Equipment for sampling



- A stainless steel Hoffer sampler is an ideal tool for taking soil samples. A Hoffer sampler can be supplied or purchased by contacting Scion.
- A spade may be used if a Hoffer is unavailable or if the soil is difficult to sample. Be careful to sample perpendicular to the surface and take consistent soil volumes and depth at each point.
- A table knife for defining clear soil boundaries; clean bags; tags and vivid marker pen.

## What happens at the laboratory

- After samples are unpacked and logged in, a unique laboratory number is given to each sample for precise identification throughout the analytical process.
- The samples are air-dried then put through a 2mm sieve.
- The samples are analysed by chemical and/or physical tests.
- A standard soil test will determine:
  - pH of the soil
  - concentration of total carbon and nitrogen as a percentage
  - concentration of plant available phosphorus, potassium, calcium and magnesium that are available as mg/kg (ppm)
  - Results are sent back to the customer, usually within two weeks, along with an interpretation (if requested).

# Foliage sampling

## Recognising nutrient deficiency

These are some visual symptoms of nutrient deficiencies in *Pinus radiata*:

- **Nitrogen** - whole needles in crowns are uniform yellowish green. Needles are shorter than usual.
- **Phosphorus** - short yellow-tipped needles on young trees. Mature trees have narrow thin crowns, and foliage is dull greyish green.
- **Boron** - dead buds on main branches and shoots. Tree may have bushy appearance.
- **Potassium** - needle tips are lemon yellow in mid-lower crown.
- **Magnesium** - golden yellow needle tips turning brown. Restricted to upper-crown.
- **Copper** - twisted branches and the main leader. May also have fussed needles and needle tip burn.

Growth rates have already been affected by the time these symptoms appear. The aim of regular foliage sampling is to detect deficiencies *before* they affect growth.

**Note:** Other factors can cause some of these visual symptoms. Chemical analysis of foliage samples can help identify the cause.

## How to collect foliage samples

Before samples are collected for foliage analysis, divide a map of the area to be tested with sample points indicated.

1. The method used to collect foliage samples is determined by tree height:

**Trees up to 6 metres in height:** The samples are generally picked by hand.

**Trees between 6 and 11 metres in height:** Pole mounted cutters can be used. Different lengths of poles can be used for stands of different heights.

**Trees between 11 and 30 metres in height:** A shotgun can be used to collect samples. Make sure of your footing and then insert one round only. Use 28 to 36 gram load of No. 5 or No. 6 shot. Ear muffs and protective glasses are essential.

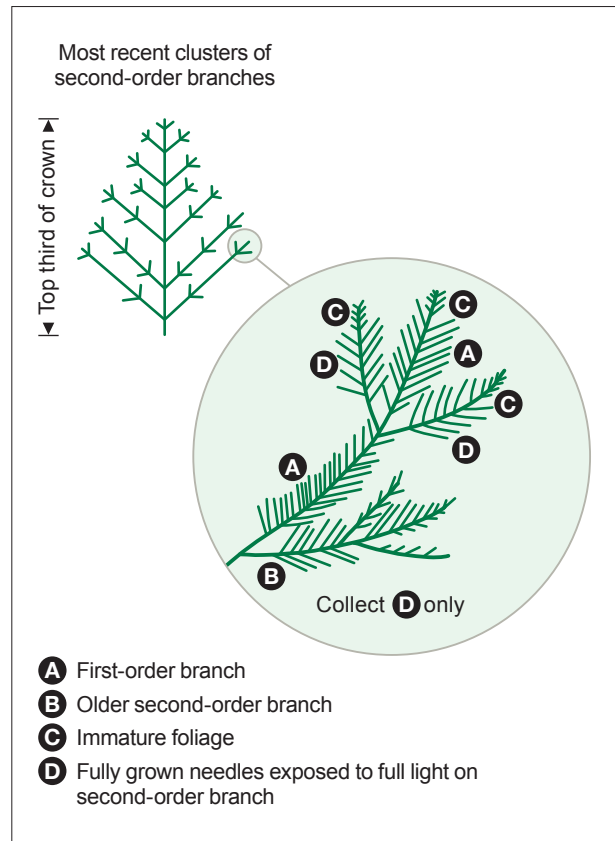
**Trees over 30 metres in height:** Samples can be collected by climbing. Trees of this height are beyond the range of a shotgun.

**Trees in dense undergrowth:** Samples can be collected using a helicopter. This method can be used for trees of any height, but specifically designed equipment is subject to Civil Aviation and Department of Labour approvals. Samples should be collected from dominant or co-dominant trees.

2. Foliage should be collected from 25 trees typical of the stand in **February** or **March** when foliage nutrient concentrations are most stable. A sample of this size will determine the level of a nutrient deficiency and possible fertiliser requirements. To determine the cause of visual symptoms, a smaller sample of 10 trees may be collected from trees showing the symptoms and compared to samples from healthy trees. Foliage can be collected regardless of weather conditions.

3. The following foliage should be collected depending on the species:

***Pinus radiata*, Douglas fir and Cypress.** Samples must be taken from fully-grown foliage on the most recent second-order branches exposed to full light in the top third of the crown. If foliage other than the second-order is collected, or if collected from lower in the crown, the identification of nutrient deficiencies based on these samples could be misleading.



***Eucalypts*.** Collect leaves exposed to full light in the top third of the crown. Leaves should be undamaged and fully expanded from the current growing season. For species that have juvenile and adult forms (e.g. *E. nitens*), adult foliage is preferred.

4. The total sample for any area being assessed should be a large handful of needles or leaves.
5. After the needles are stripped from the branches, they should be placed in a clean plastic bag and kept cold.

## How to care for and send foliage samples

1. Keep samples cool, clean and dry. Never use planting bags for storage - the fertiliser dust often present in these bags will affect the chemical analysis results. Use new plastic or paper bags.
2. Identify samples by forest, compartment and other relevant information. Fill out the **Foliage Input Form** available from the Scion website.
3. Pack samples in a strong cardboard carton with the Foliage Input Form.

4. Because foliage samples are perishable, keep them in cold storage if they are not dispatched immediately. Aim to dispatch within 24 hours.
5. Clearly mark the package **FOLIAGE SAMPLES** and send (avoiding weekends and holidays), to the address below. For further information, email [testing@scionresearch.com](mailto:testing@scionresearch.com)

## What happens at the laboratory

- After samples are unpacked and logged in, a unique laboratory number is given to each sample for precise identification throughout the analytical process.
- The samples are dried in a large forced-air oven at 70°C for about two days to preserve them in a stable condition during storage.
- The oven-dried needles are ground to a fine powder using a Wiley mill.
- Samples are analysed by a variety of instrumentation techniques for the required elements. Computer interpretations are produced from the results of analyses. These identify any nutrient deficiency problems or imbalance.

Results and interpretations are checked thoroughly by a Scion plant nutritionist for any anomalies. Using this data and the interpretation, fertiliser operations can be planned with confidence.



Ground foliage for carbon & nitrogen analysis.

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## Contact information

### Laboratory services

Email [testing@scionresearch.com](mailto:testing@scionresearch.com)

Website

[www.scionresearch.com/analytical-services](http://www.scionresearch.com/analytical-services)

## About Scion

Scion is a New Zealand Crown research institute that specialises in research, science and technology development for forestry, wood and wood-derived materials, and other bio-material sectors.

Scion's purpose is to create economic value across the entire forestry value chain, and contribute to beneficial environmental and social outcomes for New Zealand.



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**Prosperity from trees** *Mai i te ngahere oranga*