



# Soil Sampling Instructions

## 1. Introduction

The low fertility status of many Australian soils make it necessary to use fertilisers and soil amendments to encourage optimum crop production. Soil fertility can also change as a result of fertiliser use, removal of nutrients in farming produce and nutrient losses in other ways, eg. erosion. Sustainable, productive and profitable farming systems are dependent on balanced nutrient inputs. In this respect, soil sampling and subsequent laboratory analysis is an important management tool, providing a valuable guide to the various inputs required.

The results of soil analysis are only as good as the sample sent to the laboratory. Soils can vary considerably over relatively small distances, even in paddocks of apparently uniform soil type. Consider this, in one hectare of land there are about 1,400 tonnes of soil within the top 10 cm, and a "sample" weighing less than a kilogram of this soil is sent to the laboratory - therefore particular care is required in sampling to ensure the sample represents the paddock.

Soil sampling is the process of collecting representative soil samples from an area of land. These samples are then sent to the Nutrient Advantage Laboratory for assessment of some important chemical and physical attributes.

**Many of the problems with soil testing may be traced back to sampling errors, so it is important to get the process right.**

This guide will help soil samplers obtain representative samples, so the best possible use can be made of the Nutrient Advantage service.

## 2. Why Soil Sample?

The answer to this question should guide the way a sample is taken. Soil sampling and analysis is a valuable Nutrient Advantage tool, providing insight into the nutrient and general fertility status of surface (and if analysed, sub-surface) soil layers.

Soil analysis is normally undertaken for one of three reasons. These are:-

- **Predictive** - to check on the soils fertility or nutrient status, to better determine or predict nutrient requirements,
- **Monitoring** - to assess the suitability of current management practices over time, adjusting existing fertiliser programs if necessary to ensure optimum yields are achieved,
- **Diagnostic** - to determine the reason for poor growth (trouble-shooting), or to check on accumulation of mineral elements toxic to plants.

The end result, and perhaps prime objective, is to arrive at a fertiliser recommendation tailored to the individual requirements of each production system.

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### **3. When to Sample:**

The time of soil sampling will depend on a number of factors. The following are general guidelines. In trouble-shooting situations, plant tissue samples should be taken at the same time as surface and sub-surface soil samples.

**Avoid sampling within 3 months of liming or 2 months of applying fertiliser**

#### **Southern Pasture and Cereals:**

In Southern Australia, soil sampling is usually conducted in the late summer or early autumn after the opening seasonal rains.

#### **Northern Grain and Cotton:**

In Queensland and North-West NSW, sample 3-4 weeks before planting if the intention is to determine planting (phosphorus) requirements, earlier if pre-plant nitrogen requirements need to be determined.

#### **Pasture:**

For phosphorus, sample about one month before the planned time for topdressing, usually autumn or spring.

#### **Vegetables:**

For horticultural row crops, soil sampling is required several weeks prior to planting, to determine basal fertiliser requirements. However, if there is a likely requirement for lime or gypsum, sampling is required 2 to 3 months prior to planting to provide enough time for effective soil amelioration. Sub-surface samples are also recommended in situations where salinity or acidity are potential problems.

#### **Tree Crops:**

For horticultural tree crops, soil sampling is generally required in late winter or early spring or at the same time as is recommended for plant tissue sampling. Sub-surface samples are also recommended at this time where required.

#### **Sugar Cane:**

For plant cane, sample about one month before planting to determine planting fertiliser requirements. If soil amendments, eg lime, are likely to be required, sample soon after harvest so corrective action can be taken at the start of the fallow period. Alternatively, eg for "plough out and replant" cane, consider sampling during the last ratoon.

For ratoon cane, sample soon after harvest in the May to October period. Where sampling as part of a routine monitoring program, sample as near as possible to the same time of year on each occasion samples are taken.

### **4. Selecting Areas for Sampling:**

When considering which production areas to sample there are a number of factors to consider. Ideally, it would be great to sample every production unit or soil type, however time and costs may make this approach unfavourable.

In selecting areas for soil sampling consider the following:

- Sample high and low yield areas separately,
- Don't mix soil samples from different production systems, or areas which have been farmed separately
- Where different soil types occur within the same paddock or production system sample each separately,
- When establishing a new crop, consider sampling the sub-surface as well as the surface, to identify any salt or structural problems at depth.
- When trouble-shooting (especially for horticultural crops) take soil samples (surface and sub-surface) along with plant tissue samples from both the good and the poor areas.

Take care not to sample from the following situations:

- Unusual areas, eg. stock camps, dam sites, within 10 to 20 m of current and old fence lines, timber burns, headlands, the corners of paddocks which have been cultivated or planted from the perimeter inwards, poorly drained areas, gilgais or melon holes, etc.
- Areas of poor growth or excessively good growth, eg. dung and urine patches in crops or pastures.
- Areas of differing soil type, drainage patterns, fertiliser usage and cut and fill areas.

## 5. So, what is a Representative Soil Sample?

A representative sample consists of a large number of soil cores taken from within a uniform area of a soil type or paddock of concern.

For surface samples, it is important that at least 25 cores be taken, as it has been proven that samples made up of less than 20 cores often do not correctly represent the sampled area. If a sample is taken from a large area (say 50 or more hectares), it is often advisable to take more than 40 cores to make up one sample. Collected cores are then mixed thoroughly together and a sub-sample is taken to send to the laboratory. The sampling pattern and depth reflect that used when the field calibration of soil tests was conducted by the researchers.

For sub-soil samples, 8-10 cores will usually suffice, as subsoils show less variability than surface soils.

## 6. Where to Sample

### General Procedures:

For **pastures, prepared seedbeds**, and winter cereals and other crops grown at narrow row spacing (<25cm), under zero or minimum till, samples should be taken across a representative part of the whole area in a zig zag or grid pattern, or by taking cores across a permanently marked transect.

Sampling soils in fields under **row-crops** or **permanent beds** can give misleading results. Where the location of the fertiliser band is known, a representative sample consists of cores taken from within the fertiliser band and between the fertiliser band.

The number of cores, **S**, taken between the rows for every soil core taken within the row is determined by the equation:

$$S = \text{row spacing (cm)} \times 0.262,$$

ie. for 100 cm row spacing, take 26 cores between the rows for every 1 core taken in the row (fertiliser band).

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When the location of the fertiliser band is not known, the best practice is to collect sub-samples in pairs, the first one at random and the second at a distance of half the band spacing and perpendicular ie. at right angles to the band direction.

Where **beds are permanent or already in place**, in **furrow irrigated soils**, it is advisable to remove the top 5 cm of soil from the sampling position before sampling, as salts will have concentrated in this layer of soil in water drawn to the surface by evaporation.

For **tree crops**, soil samples should be taken from the zone of maximum root growth and fertilization, extending from about 30 cm from the base of the tree to just outside or 30 cm beyond the drip zone of the tree. Where under-tree sprinklers are used to apply water and fertiliser, sample cores should be taken from the wetted zone, where most of the feeding roots are growing.

### **For Trouble-shooting**

When trouble-shooting or wishing to compare one soil type/poor growing crop or area/paddock with another, always take two separate, representative samples. Plant and water samples may also assist in resolving the problem.

### **For Monitoring**

Soil fertility can vary within a field, so comparisons between one sampling time and another can be less meaningful where soil testing is used as a monitoring tool, particularly in large paddocks. This can be overcome to a large extent by selecting a smaller and permanent monitoring site, the position of which is recorded for future reference.

A simple form of monitoring site is to use a permanently marked transect, eg between two posts or objects. Alternatively, in large cropping and **pasture paddocks**, select 4 or 5 sites typical of different areas of the paddock and take separate samples from these. Each should be 10 to 15 m in diameter (no more than 20 m). Mark the locations on a map and label samples A, B, C, D. When the results are back, select the most typical representative site(s) for future sampling.

Avoid using steel posts or stakes within paddocks as markers, as they attract stock or be knocked out of the ground by animals or machinery, or cause injury or damage if concealed by tall grass.

White painted discs or metal plates placed flat on ground may be suitable in permanent pasture.

When monitoring tree crops, soils from around 20 to 25 typical trees (marked for future reference) should be sampled. These samples need to be from the same variety, root stock, crop age, and soil type.

## **7. Depth of Sampling:**

The soil sampling depth for any crop is based on the depth sampled when the soil test calibration experiments were conducted and generally relates to the zone of maximum feeding root activity. This will vary for each crop and pasture type. To assist in making reliable and meaningful fertiliser recommendations, the soil sampling depth used in local fertiliser response trials should be used when soil sampling.

In most situations, it is the topsoil which is of most interest when soil sampling. The topsoil is defined as the most recently formed soil, containing organic matter (humus) and is of highest nutritional value to plants. Most fertilisers are applied to the soil surface, or incorporated into the topsoil by cultivation.

Nutrients such as phosphorus are concentrated in the top-soil. It is this layer of soil in which the fibrous feeding roots of most crops are located. Topsoil sampling depth varies depending on the crop grown, but generally ranges from 0 to 25 cm.

Sub-surface sampling may also be necessary to check for salinity, sodicity, acidity and nutrient deficiencies or toxicities which may affect growth, particularly of deep rooted species. Deep or sub-surface sampling is also commonly used for cotton and cereal crops to measure the nitrate nitrogen status of the profile. Sub-surface sampling may also be used in pasture and annual horticultural row crops when investigating areas susceptible to salinity or soil acidity and where structural problems may limit plant growth.

**Table 1: Recommended surface soil sampling depths**

Crop	Qld	NSW	Vic / SA
Pasture	0 - 10 cm	0 - 7 cm	0 - 10 cm
Cereal, Oilseed & Grain Legumes	0 - 10 cm	0 - 15 cm (North)	0 - 10 cm
		0 - 10 cm (South)	
Cotton - pre bed form	0 - 15 cm	0 - 15 cm	Not Grown
Cotton - from beds	0 - 30 cm	0 - 30 cm	Not Grown
Cotton - raingrown	0 - 10 cm	0 - 10 cm	Not Grown
Vegetables	0 - 15 cm	0 - 15 cm	0 - 15 cm
Bananas	0 - 25 cm	0 - 10 cm	Not Grown
Sugar Cane	0 - 25 cm	0 - 25 cm	Not Grown
Tree Crops (Establishing)	0 - 30 cm	0 - 30 cm	0 - 30 cm
Tree Crops (Bearing)*	0 - 15 cm	0 - 15 cm	0 - 15 cm

\* Note:

In tree crops, remove the first centimetre of soil before sampling top soil, to remove any soil contaminated with chemicals eg copper or containing residual lime etc. Such nutrients may be positionally unavailable to the tree roots within the soil, and their inclusion may give misleading results.

**Table 2: Recommended sub-surface soil sampling depths**

Crop	Qld	NSW	Vic / SA
Pasture	N/A	N/A	10 - 30 cm
Cereal, Oilseed & Grain Legumes	10 - 60 or 90 cm	15 - 60 cm	10 - 60 cm
Cotton	10 - 60 or 90 cm	15 - 60 cm	Not Grown
Horticultural Row crops	15 - 60 cm	15 - 60 cm	15 - 60 cm
Bananas	N/A	10 - 20 cm	Not Grown
Horticultural Tree Crops (Establishing)	30 - 90 cm	30 - 90 cm	30 - 90 cm
Horticultural Tree Crops (Bearing)*	15 - 90 cm	15 - 90 cm	15 - 90 cm

N/A = Not applicable

## **8. Sampling Tools**

There are at least three types of soil samplers available and the use of these is recommended where possible, as they not only simplify sampling, but they also can increase sampling accuracy and reduce the possibility of contamination.

### **Shallow Probe**

The shallow steel sampler is suitable for taking surface samples from a wider range of soil conditions, to depths of up to 30 cm.

The depth is set by moving the adjustable foot to the required level. The sample is then taken by treading on the foot until it is against the soil surface, then pull the sampler out and invert it into a bag or bucket to empty the sample.

### **Deep Soil Probe (Thin-Walled)**

Sometimes it is necessary to take samples below the topsoil ie to a depth greater than 15 to 25 cm, so nutrients and soil conditions can be examined in the sub-soil. Using the thin-walled deep sampling probe, under the right soil conditions, soil samples can be taken to a depth of 60 cm or to the depth of the wetting front (moist soils with more than 10% clay).

These samplers work better if they are lightly oiled with a low nitrogen oil which can be applied using a 12 gauge shot gun cleaning rod. The low nitrogen oil can also be used on the surface soil sampler.

Sub-soils are generally less variable than surface soils, so only 8 to 10 cores are usually necessary for deep sampling.

### **Hydraulic Probes & Motor Driven Augers**

Hydraulic probes are used primarily to take profile soil samples for soil nitrate, sulfate, salinity and sodicity assessments. Samples are generally taken down to 60 or 90 cm using a hydraulic probe device mounted onto a vehicle.

In grain and cotton areas, many dealers are equipped with hydraulic probes. As for sub soil samples, 8 – 10 cores is usually required for deep sampling to give a representative sample. Use a low nitrogen oil to lubricate probe tubes.

Hand held motor driven augers are also used to take profile soil samples.

### **Soil Sampling with a Shovel or Auger**

At times, it is not possible to use the normal sampling equipment, because the soil is too hard to penetrate or the soil is too dry (for sands) to stay in the tube or too heavy to get out of the sampler.

In these cases, samples can be collected using a spade or trowel, or a jarret auger. Dig a hole to the depth required, then cut a vertical 2 cm slice of soil from the face of the hole. Trim away soil from both sides of the spade, leaving a 2.5 cm strip of soil down the middle of the spade, which becomes the sub-sample required. The same number of sites should be sampled as when using the tube - type samplers ie 25 plus.

## 9. How to Take a Soil Sample:

1. Ensure your hands and equipment are clean before commencing sampling.
2. Select an area for sampling which is typical or representative of the area.
3. Using the metal sample probe, take at least 25 cores to the same depth across the area of concern, in a grid, spiral or zigzag pattern or along a transect with permanently marked ends. The more cores taken, the more accurately the final sample will represent the paddock.
4. Scrape away surface debris, undecomposed stubble or other organic matter, but do not disturb the soil surface. If the soil is “fluffy” from cultivation, tamp the soil firmly with your boot.
5. Push tapered sample tube, narrow end first, into the soil to the desired depth, give a half turn and slowly withdraw it from the hole.
6. If soil tends to fall out of the tube before it is completely withdrawn, place hand over top of tube and raise slowly or in dry sandy soil, tip the tube sideways to hold the core in.
7. Tip the tube upside down over a clean plastic bucket, or directly into a clean plastic bag, emptying contents out of the handle end of the tube. If a core appears atypical of the rest, then discard the core and take another. Do not collect into a galvanized bucket.
8. After collecting 25 or more cores in the bucket, break up cores into small crumbs and mix them thoroughly into a composite sample.
9. If the sample is too large, select a representative sub-sample by the quartering technique or by taking 100 g of the sample, placing it in the sample bag, remixing the remainder, then taking another 100 g sub-sample, continuing the process until the required amount is obtained. Transfer the representative sub-sample into the soil sample bag provided (about 500 g is required by the laboratory).
10. Complete the Test Order Form by inserting the Dealer Store details, the grower's name and contact details and the sample identification. You should also advise the laboratory the test name and other requested details of the sampled site. Place this form with the soil sample(s) in a suitable padded bag or envelope for transport. Send the pack to the Nutrient Advantage laboratory via a reliable Express Courier service or Express Post for overnight to 3-day delivery.
11. The dealer who takes the sample should also record all the relevant site details for each sample. Information of relevance is :- crop or pasture species to be grown (or growing), row spacing, details of previous year's fertiliser and soil amendment application, rainfall, whether irrigated or not, stubble amount and treatment, rotations, weeds, diseases and insect pests present and the control methods used and any other management practices which may affect the soil's nutrient status.

## 10. Test Order Forms

The Test Order Form should be filled in, recording the details of up to 6 samples. The information required is essentially to identify the samples and order the suite of analyses required. Hence dealership details, grower name and contact details, paddock name and several other but relevant details of the site.

All other relevant information about the crop to be grown and previous fertiliser and crop protection history, irrigation type, etc should be recorded by the dealer to assist with the interpretation of the results.

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## 11. Sample Handling and Transport

Once a sample is collected, the main objective is to dispatch it to the laboratory as quickly as possible, so it reaches the laboratory in a condition as close as possible to that when it was collected.

Soil samples are best kept in plastic bags, but because most samples contain moisture, microbial activity will continue while suitable temperatures prevail.

Don't expose the sample to extreme heat, eg. on the dash board, in the back of a utility or truck, or leave it in a locked up vehicle during the heat of the day. It is recommended that bagged soil samples be transferred to an esky or cool box, containing cooler bricks or dry ice, as soon after sampling as possible. Carry one with you in your vehicle if some time will lapse between when you take the sample and return home. Samples can be transferred to a refrigerator or freezer for storage overnight or until ready to dispatch.

**This procedure is particularly important where nitrate-nitrogen and sulfate-sulfur tests are required.**

The chances of biologically-induced changes to the chemical properties of the soil are reduced if this advice is heeded.

Remember to send samples on the day of sampling or the next day. Avoid posting samples late in the week eg on a Friday (as they will sit in the Post Office or in transit over the weekend). If soil samples are taken late in the week, store them in the fridge or freezer over the weekend.

An alternative to cooling is to air-dry the soil, so moisture is removed sufficiently to prevent microbial activity. The sample can be spread out on a clean plastic sheet or bag in direct sunlight, away from any likely contamination.

Samples should be placed with the Test Order Form in a suitable padded bag for transport to the Nutrient Advantage laboratory. The dealer should arrange a reliable Express Courier service or Express Post to allow the samples to reach the laboratory as quickly as possible. The transit time will vary from overnight for some locations to 3 or 4 days for others.

## 12. Summary of key points

The soil sampling musts;

- ❑ Must sample at a time which allows for the analysis of the sample and its interpretation in advance of the time for the recommended treatment. In most situations, this will be 3-4 weeks before fertiliser is to be applied. Where acidity, salinity (salt) or sodicity (poor soil structure) is expected to be a problem, soil analysis is recommended several months prior to planting to provide time for lime or gypsum to be applied and take effect.
- ❑ Sample must be representative of the area or soil type of concern or interest. For shallow samples ie of topsoil, take at least 25 cores.
- ❑ Must use clean sampling gear, bucket and sample bags.
- ❑ Must ensure cleanliness throughout the sampling procedure.
- ❑ Must avoid potential sources of contamination such as soil, fertiliser or chemicals in buckets, used sample bags or sampling gear, cigarette ash and oxidised zinc from galvanised buckets or fencing materials and hands or other items which may touch the soil sample.
- ❑ Must avoid handling the sample with bare hands in hot weather (use a trowel).
- ❑ Must avoid atypical areas such as stock camps, fence lines (including those which existed in the past) and around trees.
- ❑ Must sample at least 3 months after liming and 2 months after last fertiliser application.
- ❑ Must sample to the correct depth for the crop or pasture.
- ❑ Must provide a sufficient volume of soil (>25 cores) for the laboratory to conduct all analyses, eg. 500 g.
- ❑ Must avoid sampling in climatic extremes, eg. water-logged soil, drought.
- ❑ Must avoid exposing the soil sample to heat for prolonged periods. Place in cooled esky as soon as possible after sampling, especially if nitrate nitrogen or sulfate sulfur is to be measured.
- ❑ Must draw and retain a rough sketch of the farm or paddock marking each sample area with the number/s assigned to the samples when establishing monitoring sites.
- ❑ Must correctly fill out the Test Order form.
- ❑ Samples must be sent to the laboratory immediately after collection. If undue delay is likely, the sample should be stored in the bottom of a refrigerator or in a freezer.
- ❑ Dispatch must be quick, eg. use a reliable Express Courier service or Express Post for overnight or up to 3-4 day transport, depending on your location.

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