



Information Sheet

7.16 Soil sampling procedures



Soil sampling and testing are essential management practices that a grower can use to improve the value of their investment in nutrients, as well as identify certain crop limiting conditions. Soil sampling and analysis allows us to:

- Determine the capacity of the soil to support plant growth.
- Determine the nutritional status of the soil and identify deficiencies or toxicities.
- Guide nutrient or remedial amendment requirements to ensure good plant growth.
- Monitor changes in the soil due to management activities.

For soil testing to provide accurate assessment of the soil fertility status, the sample being analysed must be truly representative of the area under consideration. Consider that a few grams of sample used in the laboratory represents many thousands of tons of soil in the field. The following factors and guidelines should be considered for optimal benefit of the soil sample.

Note: No single, simple set of guidelines will apply to every sampling situation. The general principles will need to be adapted for each field and situation to get the best from the effort.

When to sample

- Samples can be taken at any time of the year. It is essential to allow enough time for sample analysis so that fertilisers can be purchased and applied at the correct time. Sampling for a replant and ratoon cycles should be done as soon as possible after harvest. This is particularly important where amendments such as lime might also be needed, as these can take time to be delivered and also require enough time to react in the soil before replanting occurs. If accessible, soils can also be sampled **before the last ratoon crop is harvested**.
- It is advised to sample before the planting of green manure crops so that issues such as acidity can be addressed sooner and improve the performance of that green manure crop.



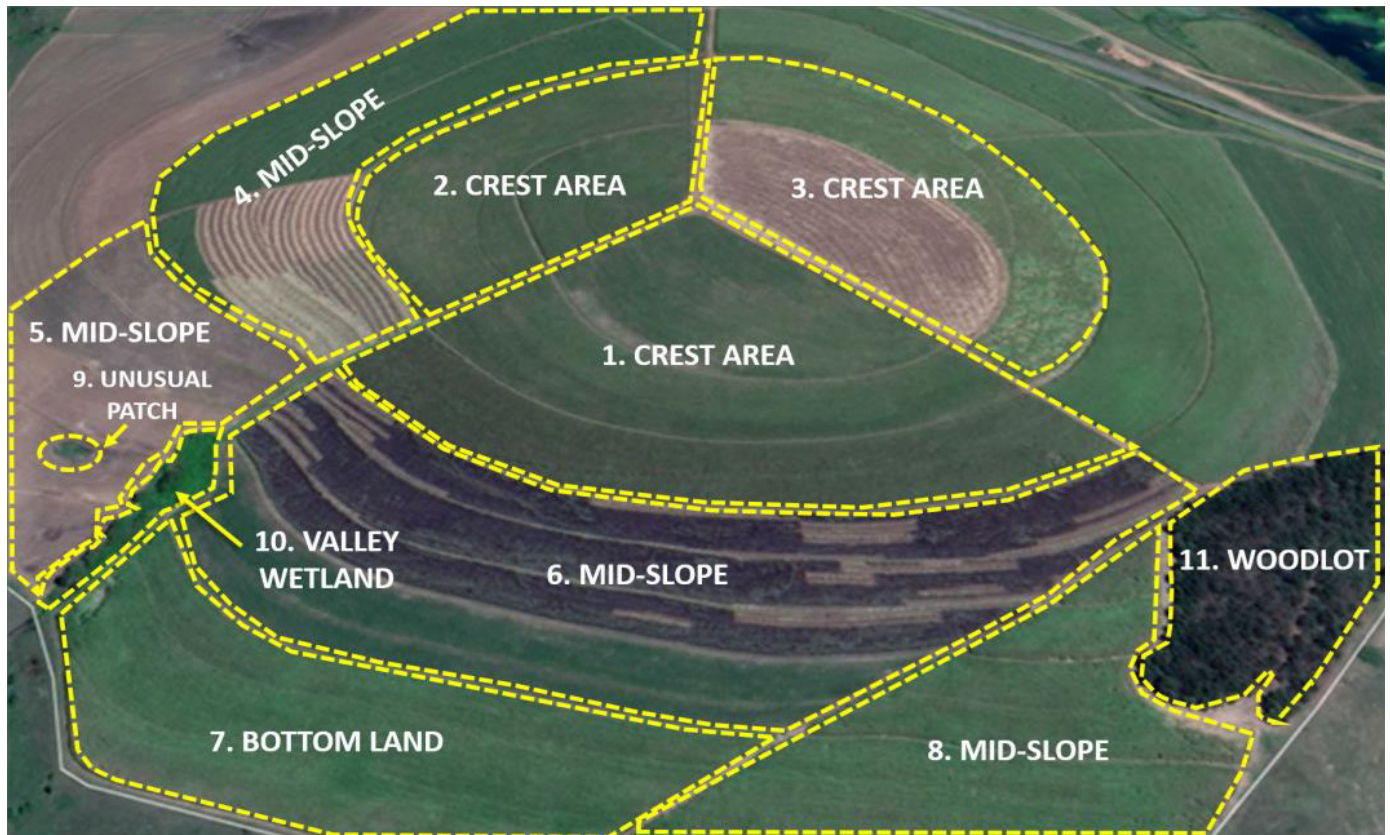
How often to sample

Ideally, samples should be collected after **every harvest**. This allows for more accurate recommendations to be made for each crop. However, it is recognised that some growers may not have the capacity to undertake sampling at this intensity. In these cases, the maximum period between sampling events should be limited to sampling after every third harvest (e.g. if sampled for planting, then next sampling must take place at the end of the **second ratoon harvest**).

Leaf testing is also strongly advised in years where soil sampling is not undertaken to ensure adequate nutrient levels in the plant.

Selecting the area to sample

The sampling unit must be representative of the field or management unit (i.e. an area that will be treated similarly with respect to fertilisation, liming and green manuring). This may vary from less than a hectare to several. In general, it is advised that a sample not represent any area larger than 5 ha, while smaller areas may be better where there is high variability in soils and management practices. Regardless of the size, the area to be sampled should be relatively homogenous (similar) with respect to soil properties. Avoid sampling anomalous areas that don't represent the general field conditions. This includes features such as ant hills, old roads, loading decks and loading or handling areas for organic amendments, fertiliser, lime and gypsum. Where there are underperforming areas in a field, sample these separately from the remainder of the field.



▲ An example of a field with sampling units identified. Areas 1, 2, 3, 4, 5, 6, 7 and 8 will be sampled separately. The unusual patch 9 is a problem area and must be sampled separately to identify the problem. Areas 10 and 11 can be omitted as they are not for crop production.

Topsoil sampling procedure

- For routine topsoil fertility assessment, soils must be sampled to 0 to 20 cm depth. Sampling to this depth is most conveniently done using the Beater auger (bicycle handle auger) with a 20 cm coring bit attached. This sampling tool ensures a consistent depth and volume of soil is collected.
- Attach a heavy duty, clear (aids observing the samples collected), plastic bag onto the beater soil sampler. A string or elastic band can be used to tie the bag to the sampling corer.

Beater Auger for topsoil fertility sampling. ►



Topsoil sampling procedure (continued...)

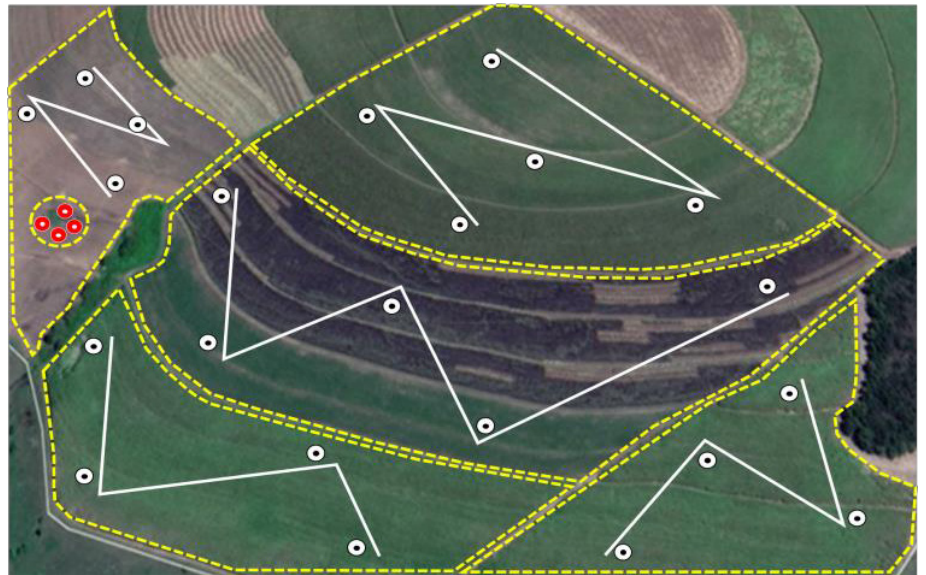
- Clear away the crop residue/mulch (tops and leaf material) and then push the sampler into the soil using your foot to ensure it goes into the full depth of the corer (20cm), as shown in the picture on the right.



- Gently pull the soil sampler out with a twisting motion, invert and give the corer a few light blows with a wooden peg to ensure all the soil falls through.
- Move to the next spot and repeat steps 2 and 3 until 20 to 30 cores (subsamples) have been taken. NB: ensure that you follow a zig-zag pattern when taking the soil samples (below), ensuring coverage of the entire area to be represented.



Zig zag patterns showing how to collect topsoil fertility samples (white lines). White dots indicate possible sampling locations for subsoils. Red dots show area that needs separate sample to identify cause for differences to rest of field. In tilled or broadcast fertiliser fields, the pattern can be randomly applied. ►



- Once you have taken enough core subsamples, take the sample bag off the sampler and thoroughly mix the soil to ensure a well-mixed homogeneous sample in the packet. Break up larger soil clods to aid mixing and improve sample representation. Remove any stones or larger sections of roots that may be present.
- Fill an FAS sample box with the well-mixed soil sample and be sure to fill in your name, contact number, grower number, field number and soil depth on the box.
- Along with the soil sample, fill the soil submission form, making sure that all the important details such as the crop (plant or ratoon), anticipated yield and all grower details are provided. N.B. the field number (sample identification) on the box and on the submission form must be identical!
- Take the soil samples and submission forms to FAS directly or deposit them in one of the collection bins that are provided by SASRI throughout the industry.



Caution: Incorrect sampling depth can lead to biases in the fertiliser recommendations. As many nutrients such as P and K tend to accumulate near the surface, sampling to shallower depth (e.g. 10 cm) leads to higher soil test values and consequently lower fertiliser application rates, potentially leading to under supply for the crop. Conversely, sampling to greater depth (e.g. 30 cm) often leads to a dilution effect and lower soil test value, thus a higher fertiliser recommendation. This can result in the oversupply of nutrients (higher cost) without benefits for the crop.



An English and Zulu video is available on FAS Agricultural Laboratory website (www.fasagrilab.co.za).

Sampling patterns for fertility assessments

Due to differences in field management, fertiliser application strategies and nutrient behaviour in the soil, the following guidelines can be used to guide an appropriate sampling approach.

Guidelines for sampling patterns depending on prior fertiliser and land preparation management

Condition	Previous fertiliser application method	Sampling protocol
Field tilled or ploughed before sampling	Broadcast or banded	Take 20 to 30 cores across the field using the zig zag pattern (increase sample number to 40 for areas larger than 2 ha).
Ratoon or no-till fields (no or minimal soil disturbance)	Broadcast fertiliser	Take 20 to 30 cores across the field using the zig zag pattern (increase sample number to 40 for areas larger than 2 ha). Take samples from the interrow* areas only.
	Predominantly side-dressed or banded along the row (including drip fertigated)	Take one soil core in the row for every eight in the interrow* across the field. Cores from the interrow should be spread evenly between the row areas. Take a total of 27 to 36 cores.
	Predominantly banded in the interrow	Take one core in the area where the band of fertiliser was applied for every eight in the interrow where fertiliser was not applied. Cores from the interrow should be spread evenly between the row areas. Take a total of 27 to 36 cores.
	Mixed broadcast and banded	Follow pattern for banded fertiliser applications above (row side dressed or banded interrow*).
	Unknown prior fertiliser placement	Take 40 to 60 cores across the field from the interrows* only. Use the zig zag pattern.
Problem patches	Any of the above	Sample the bad and the good patch using the closest matching protocol described above.

* **Note:** Avoid sampling compacted interrows that are used for controlled traffic. Where unavoidable, consider sampling between compacted region and cane row.

Subsoil acidity sampling (20 to 80 cm; mostly rainfed regions)

Besides topsoil sampling, there is also a need to sample the subsoil as sugarcane roots are not restricted to the top 20 cm of soil, but may penetrate to a depth of about a metre or more. However, subsoil acidity can be problematic mainly in the rainfed areas of the industry and limits deep root growth.

Subsoil acidity sampling (20 to 80 cm; mostly rainfed regions) continued...

- Subsoil acidity sampling is done in 20 cm increments to a depth of at least 80 cm (i.e. 20 to 40, 40 to 60, and 60 to 80 cm; 80 to 100 optional). Sampling to shallower depth than 80 cm severely limits the value of the analysis as corrective recommendations will be incomplete. If sampling depth restrictions are present at shallower depths then collect to the maximum possible. An open bucket (dutch) auger is used (picture on right). The shaft can be appropriately marked to aid sampling.
- Since subsoil tends to be less variable than the topsoil (and subsoil sampling is laborious), the process only needs to be done on four to six randomly selected sites across the field.
- Group the samples from each sample depth interval into a composite sample and thoroughly mix.
- Separate into subsamples and place into FAS boxes. Where there are specific problem patches, these should be sampled as above, but separately from the better areas or remainder of the field.



Open bucket (Dutch) auger showing markings to aid sample collection for subsoil acidity or salinity/sodicity sampling. ►

Salinity/sodicity sampling (0 to 90 cm; mostly irrigated regions)

- In the irrigated regions, profile sampling is done mainly to evaluate soil salinity and sodicity problems.
- For salinity and sodicity assessment, samples are collected at 0 to 30, 30 to 60 and 60 to 90 cm depth. It is advised to collect samples to the maximum depth indicated, unless a soil depth restriction exists (in which case collect to that depth). Use an open bucket auger (Dutch auger).
- Since subsoil tends to be less variable than the topsoil (and subsoil sampling is laborious), the process only needs to be done on four to six randomly selected sites across the field. Where there are specific problem patches these should be sampled as above, but separately from the better areas or remainder of the field.

Sampling for precision agriculture applications



There is increasing interest in **grid sampling** for precision agriculture applications. However, adoption of precision agriculture sampling approaches requires careful consideration.

It is difficult to advise on the ideal grid size and sampling approach as this will require site specific designs that align with the management objectives. The use of soil mapping, electromagnetic induction or related geophysical surveys and examination of spectral imagery (NDVI, hyperspectral from drone or satellite), is suggested as a key preliminary step in identifying site variability, which may be able to guide better sampling strategies before actual soil sampling is undertaken. It is advised that a specialist with experience in grid sampling/precision agriculture be consulted where such an approach is being considered.

Cautionary notes

- Many of the anomalous results from laboratory testing can be traced back to improper sampling or sampling errors, mislabelling of samples or contamination during handling. Ensure best practices are followed so as to get the best value from the analysis. Do not collect soil samples in old fertiliser bags or containers that may have been contaminated as these will lead to erroneous analytical results. Storing of sample boxes in the back of trucks where other contaminants are present also pose a risk.
- Avoid collecting samples using spades or galvanised/plated equipment, as this leads to bias in the way the sample is collected and possibly zinc and copper contamination.
- Attempt to keep sampling pattern consistent between sampling events (i.e. use a similar method and pattern for sampling).

Additional resources and notes

- Soil samples boxes are available from the FAS Agricultural Laboratory or your regional Extension Specialist.
- Submission forms can be downloaded from the FAS website (www.fasagrilab.co.za) or obtained from FAS Agricultural Laboratory or your regional Extension Specialist.
 - Ensure the submission form is completed correctly and fully using legible handwriting.
 - Ensure that a realistic target or attainable yield for the crop in the upcoming season is specified in the submission form. Failure to fill this in results in recommendations using a default 75 tc/ha. Inserting an inappropriate value will result in over or under estimation of actual crop needs. See the Information Sheet: A guide on how to fill a soil fertility submission form for further detail.
- Beater and open bucket augers can be purchased through the FAS Agricultural Laboratory or SASRI Extension Office.
- Some Regional Extension Offices may lend or hire sampling equipment – consult your Extension Specialist for availability.
- Sample boxes can left at your regional drop off point for free delivery to FAS. Samples are collected once a week, so this can lead to delays in processing. Visit www.fasagrilab.co.za for a list of drop-off points and collection times. Alternatively samples can be couriered or delivered directly to FAS.
- Visit the SASRI e-Library (www.sasri.org.za) for information sheets and guides on soil nutrition and sample reports.

Louis Titshall (Senior Soil Scientist)

October 2022