SOIL SAMPLING

SELECTING A REPUTABLE LABORATORY AND CORRECT SOIL ASSAY

Sugar Research Australia

INTRODUCTION

After following industry best practice to collect a soil sample the next critical decisions relate to laboratory and soil assay selection. There are different commercial soil testing laboratories offering a range of assays available to determine soil chemical, physical (and biological) properties. Selecting a reputable and reliable soil testing laboratory and correct soil assay are critical for identifying nutrient requirements and soil chemical constraints. Major factors to consider when making this selection include:

Laboratory proficiency and competency

Participating in Australasian Soil and Plant Analysis Council (ASPAC) proficiency trials and maintaining certification for the nominated soil analytical methods where available, can be used to identify if a laboratory is suitable for performing chemical analysis of soil samples. Certified laboratories may display the ASPAC logo on their soil test reports.

The National Association of Testing Authorities (NATA) accreditation is another effective means to identify a technically competent soil testing laboratory. This involves professional laboratory auditors and leading agricultural laboratory scientists independently auditing laboratory performance for compliance to the AS/ISO 17025 standard for laboratory quality and traceability. However, it also is important to understand which test offerings NATA have accredited for the laboratory. This can be found on the NATA website (https://nata.com.au).

The provision of credible and validated test results is more certain when using a lab that is both ASPAC certified and NATA accredited for most of the soil assays offered.

Soil assay requirements

Laboratories offer different soil testing packages (test codes) to meet a range of requirements.

For sugarcane, the specific assays required to interpret a soil test using the SIX EASY STEPS™ guidelines are provided in Table 1 on next page.

Soil assay requirements (continued)

Table 1: Assays required to interpret a soil test using the SIX EASY STEPS nutrient management guidelines

SOIL ASSAY	UNIT	DESCRIPTION
Soil pH (1:5 water)		Used for acid soils. A measure of acidity and alkalinity.
Soil pH (1:5 $CaCl_2$)		Used for alkaline soils (mostly in the Burdekin). A measure of acidity and alkalinity.
Cation Exchange Capacity (CEC)		An indication of the soil's nutrient holding ability.
Calcium (Amm-acet.)	cmol+/kg or meq/100g	A measure of the soil's available calcium.
Magnesium (Amm-acet.)		A measure of the soil's available magnesium.
Exchangeable Sodium Percentage (ESP)	%	The amount of sodium as a proportion of all cations in the soil.
Silicon ($CaCl_2$)	mg/kg	A measure of the soil's available silicon.
Silicon (BSES)	mg/kg	A measure of the soil's reserve silicon.
Organic carbon (Walkley Black)	%	Used to assess the organic matter level of a soil for the determination of nitrogen requirements.
Phosphorus Buffer Index (PBI)		A measure of the soil's ability to tie up phosphorus.
Phosphorus (BSES)	mg/kg	Combined with PBI, used to assess phosphorus requirements.
Phosphorus (Colwell)	mg/kg	Combined with PBI, may be able to be used in the future to assess phosphorus requirements (for alkaline soils).
Potassium (Nitric K)	cmol+/kg or meq/100g	A measure of the soil's reserve potassium.
Potassium (Amm-acet.)	cmol+/kg or meq/100g	A measure of the soil's available potassium.
Sulphate-S (MCP)		A measure of the sulphur availability in the soil.
Copper (DTPA)	mg/kg	A measure of plant-available copper. An unreliable test.
Zinc (BSES or HCl)	mg/kg	A measure of plant-available zinc (acid soils less than pH 6.5).
Zinc (DTPA)	mg/kg	A measure of plant-available zinc (alkaline soils greater than pH 6.5).

Measurement units

In addition to the assays required to support the SIX EASY STEPS interpretation of soil test results, specific measurement units are also required (see Table 1).

In some cases, measurement units can be converted to match those used in SIX EASY STEPS. These conversions are provided in Table 2.

Table 2: Measurement unit conversion factors

SOIL ASSAY	REQUIRED UNIT OF MEASUREMENT	CONVERTING PPM TO CMOL+/KG OR MEQ/100G
Calcium (Amm-acet.)	cmol+/kg or meq/100g (meq %)	Divide ppm by 200
Magnesium (Amm-acet.)	cmol+/kg or meq/100g (meq %)	Divide ppm by 120
Potassium (Amm-acet.)	cmol+/kg or meq/100g (meq %)	Divide ppm by 390
Sodium (Amm-acet.)	cmol+/kg or meq/100g (meq %)	Divide ppm by 230
Aluminium (Amm-acet.)	cmol+/kg or meq/100g (meq %)	Divide ppm by 90

Interpretation of results

Soil test reports often group soil assay results into subjective categories such as low, marginal, sufficient, high, excess. Unfortunately, the same categorisation may not be used across laboratories, and it may be unclear if these categories are crop specific or calibrated for specific soil conditions. Therefore, it is better to focus on the soil test reading and how it compares to industry established critical values.

Turnaround time

Enquire about the time taken to complete and report soil assay results once the samples have arrived at the laboratory. If soil samples are collected immediately after harvesting the final ratoon crop timeliness may not be as critical.

Cost

The cost of soil analysis can vary significantly between laboratories. When considering the cost of soil analysis, carefully review the soil assays meet the SIX EASY STEPS requirements and check the measurement units.

Other service offerings

In addition to soil analyses many laboratories can also analyse plant tissue samples. These analyses can be particularly beneficial when used to compliment soil testing. Soil testing predicts nutrient requirements whereas plant tissue (leaf) analysis can be used to assess nutrients taken up by the crop. Combining both soil and plant tissue analyses is useful for monitoring the effectiveness of nutrient management programs, identifying opportunities to fine tune nutrient inputs, diagnosing nutrient deficiencies and/or hidden hunger.

Consistency

To help reduce reporting variability, improve reliability of results and allow results to be compared across seasons, crop cycles or between blocks, it is recommended to use the same laboratory. Using the same laboratory coupled with geo-referenced soil sample collection will allow soil fertility to be monitored over time.

Growers should be aware of which laboratory their service provider is using and if the soil testing package requested meets industry best practice (refer to Table 1) and conforms with regulatory requirements. Growers should be advised of any changes to either the laboratory or soil testing package made by their advisor prior to sample submission.

Data management and reporting

Many laboratories have developed user-friendly online programs that allow users to submit samples, access and interpret results, generate recommendations and download reports. They also act as a data repository enabling access to historical soil test results. While growers cannot access these programs, it is important they are provided access to their soil test reports in their requested format. In addition to a copy of the soil test report (hardcopy or electronic), access to the soil assay results (as an excel file) is useful for developing nutrient management plans.

Critical considerations

Regularly review soil test reports to check they contain:

- ☐ ASPAC certification logo
- ☐ NATA accreditation reference
- ☐ All soil assays required for SIX EASY STEPS
- ☐ Correct measurement units
- ☐ Soil sampling date
- ☐ Grower or farm name
- ☐ Farm number
- ☐ Block number or sample location
- ☐ Advisor details

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