SOIL TESTING

FACT SHEET

GRDC
GRAINS RESEARCH & DEVELOPMENT CORPORATION

SOUTHERN REGION
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Soil testing to determine fertiliser applications

Soil testing measures soil water, nutrients and chemical parameters in the soil

KEY POINTS

- Pre-season soil testing is essential to determine a crop nutrition strategy for the upcoming season
- Growers should aim to soil test at least 20 per cent of their cropping paddocks per year. It is recommended to soil sample paddocks with the same crop (for example, all paddocks to be planted with wheat)
- Yield, biomass and other maps from previous seasons will indicate low, medium, and high production zones. Soil testing should be conducted within each production zone to determine what is driving variation in the paddock
- Topsoil samples, taken with a 0-10 centimetre pogo sampler, are used to measure immobile nutrients such as phosphorus and trace elements
- Deep core soil sampling, using a ute-mounted hydraulic corer, can measure more mobile nutrients such as available nitrogen and assess subsoil constraints to root growth
- Target a minimum of six deep soil cores for each zone and a minimum of six topsoil (0-10cm) cores taken around each deep core location. A ratio of one sample taken on the previous crop's row to eight to 10 samples inter-row is recommended by Fertcare
- The amount of plant available nutrient measured in the laboratory indicates if the soil nutrient supply is likely to be adequate or whether it needs to be boosted with fertiliser applications
- If the soil nutrient result is less than the critical level, the site is highly likely to respond to an application of that nutrient at rates potentially higher than was applied in the past or what is the standard practice
- Growers should work with their agronomist to determine a soil testing strategy pre-season. An agronomist can also help interpret and analyse the test results to determine a crop nutrient strategy for the season

Photo: AgCommunicators

Topsoil samples are taken from the top 10cm of the soil surface using a pogo stick sampler.

These measurements influence the supply of nutrients to the crop and indicate how plant growth and quality will respond to fertiliser applications at the start of or throughout a growing season.

The more growers can understand the soil in their paddocks, the easier it will be for them to optimise production.

Pre-season is an ideal time to soil test and plan a crop nutrition strategy for the upcoming season.

What is the value of soil testing?

Soil testing is essential for monitoring soil fertility and identifying constraints to root growth within the topsoil and subsoil. This information helps growers manage their farms to optimise profit.

Soil tests identify which nutrients are likely to be inadequate for crop growth, potentially limiting yield, which can be managed with fertiliser applications. Soil testing can also diagnose limitations such as salinity, acidity and poor structure caused by sodicity. These limitations constrain a crop's ability to access water and nutrients, impacting its yield potential and nutrient requirements.

What does pre-season soil testing involve?

Pre-season testing involves taking soil samples in pre-determined zones within a paddock to assess the quantities of nutrients available to plants such as nitrogen, phosphorus, potassium and sulphur. It also helps to identify soil constraints such as acidity, salinity and sodicity.

P Level 4, 4 National Circuit, Barton ACT 2600 | PO Box 5367, Kingston ACT 2604
T +61 2 6166 4500 **F** +61 2 6166 4599 **E** grdc@grdc.com.au

For large paddocks with variable soil types and crop performance, it is important to use historical yield maps, biomass or other information to identify different production zones and whether these should be managed differently. Production zones can be developed based on knowledge of soil types and crop production, including yield maps – See GRDC's Zoning factsheet for more information on production zone management.

Soil testing within different zones can help determine what is driving crop variation and how it might be addressed by the fertiliser plan.

While most nutrients are concentrated in the top 10 centimetres of soil, soil cores to depth provide essential information on deep soil nitrogen and other mobile nutrients, stored soil water and subsoil constraints such as acidity, sodicity and salinity.

Topsoil samples are taken from the 0-10cm layer of soil using a pogo stick sampler. The pogo enables several topsoil cores to be collected relatively quickly to ensure a representative sample. Target a minimum of six deep cores for each zone and a minimum of six topsoil (0-10cm) pogo samples taken around each deep core location.

Deep soil cores are collected to 90cm below the soil surface or down to a physical barrier such as rock or highly compacted subsoil. These cores require a ute-mounted hydraulic ram to push a tube into the required depth. Once the intact soil core is extracted it is cut into defined layers – usually 10-30cm, 30-60cm and 60-90cm.

Most soil samples should be collected from the inter-row. This is because the crop is normally planted between the old rows and the crop's roots take up water and nutrients from the inter-row, at least early in the season. A ratio of one sample taken on the previous season's crop row to eight to 10 samples inter-row is recommended by Fertcare.

In the GRDC 'Soil and Plant Testing for Profitable Fertiliser Use' project, growers were recommended to sample six sites within each production zone. At each of the six sites, one deep core sample (for nitrogen) and six topsoil pogo samples were taken.

For each production zone, one composite topsoil sample, consisting of six pogo samples taken around each deep core, and three composite depth samples, consisting of six deep cores which are split into depths of 10-30cm, 30-60cm and 60-90cm, are sent away for analysis.

Growers and agronomists should work together to decide which paddocks to test and how often. Many opt to test each paddock every four or five years on a rotational basis, or when a paddock is going to be planted to wheat or another cereal. Individual paddock needs and factors should be considered in this process.

Soil testing at least 20 per cent of cropping paddocks a year is an effective strategy. However, some growers may undertake more intensive testing.

The best time to take soil samples depends on what nutrients the grower wishes to prioritise. For more stable nutrients, including phosphorus and potassium, sampling can be undertaken anytime between harvest and sowing.

For nutrients which are released by the breakdown of organic matter, including available nitrogen and sulphur, testing is recommended as close as possible prior to sowing to gain a more accurate measure of how much nutrient will be available to the crop at sowing. This is important as rain after sampling will alter the amount of available nutrients.

Growers can consult an agronomist about the best soil sampling program for their particular cropping rotation.

How to collect pre-season soil samples

Topsoil samples (see Figure 1)

- Collect topsoil (0-10cm) samples with a pogo stick sampler in each pre-determined production or soil sampling zone within a two-metre radius of the deep soil core
- Push aside any plant residues on the soil surface before inserting the pogo
- In dry sandy soils, make sure none of the sample falls out of the pogo before it goes into the bucket
- Target a ratio of eight to 10 samples between last year's crop row to every sample on the row for each zone
- Put the samples in a bucket clearly labelled 0-10cm
- Mix soil well and place one subsample in a plastic soil sampling bag (usually provided by the lab) and discard the rest of the soil in the bucket
- Do NOT use the deep soil corer for collecting the top 10cm of soil. Topsoil is often high in mineral nitrogen and other nutrients, and may contaminate the subsoil. Dry topsoil can easily fall down the sides of the tube when extracting a core, especially on sandy soils

Photo: AgCommunicators

Deep core samples are taken using a ute-mounted hydraulic ram probe.

Deep core samples (see Figure 1)

- Log the GPS location of all deep soil cores in each zone for future reference or further deep N testing mid-season
- Only take deep soil core samples between last season's rows
- Before taking a deep soil core, remove the top 10cm soil with a spade to reduce the risk of topsoil contamination
- If possible, sample to 90cm depth using a ute-mounted hydraulic ram probe
- Remove the tube from soil and slowly push the soil core out into a collection tray. Try to keep the core intact
- Separate the sample into segments based on sampling depth. Generally, these are 10-30cm, 30-60cm and 60-90cm sections
- For ease of mixing, use a knife to cut the core lengthways in half to reduce the amount of soil that is collected for each depth
- Place soil for each depth range into separate buckets which are clearly labeled for each depth
- Complete this process for all sampling sites in the zone. Target a minimum of six deep cores for each zone
- Mix the contents of each bucket thoroughly, breaking up any clods. Mixing is very important to get a representative subsample
- You should end up with one representative subsample for each depth in the zone (three samples in total)

Record the sampling date along with any symptoms of disease, weather conditions, crop rotation, fertiliser history and any recent fertiliser applications. Laboratories often provide a form for this information.

Mineralisation can occur in warm moist soils which will change the available nitrogen values. Keep samples cool in an esky or fridge and dispatch samples for testing as soon as possible via express post.

Photo: AgCommunicators

Deep core sample taken using hydraulic ram probe.

Photo: AgCommunicators

Mix samples in a bucket to get a representative sample of the nutrient.

Photo: AgCommunicators

Place a representative sample of the deep cores in a plastic bag.

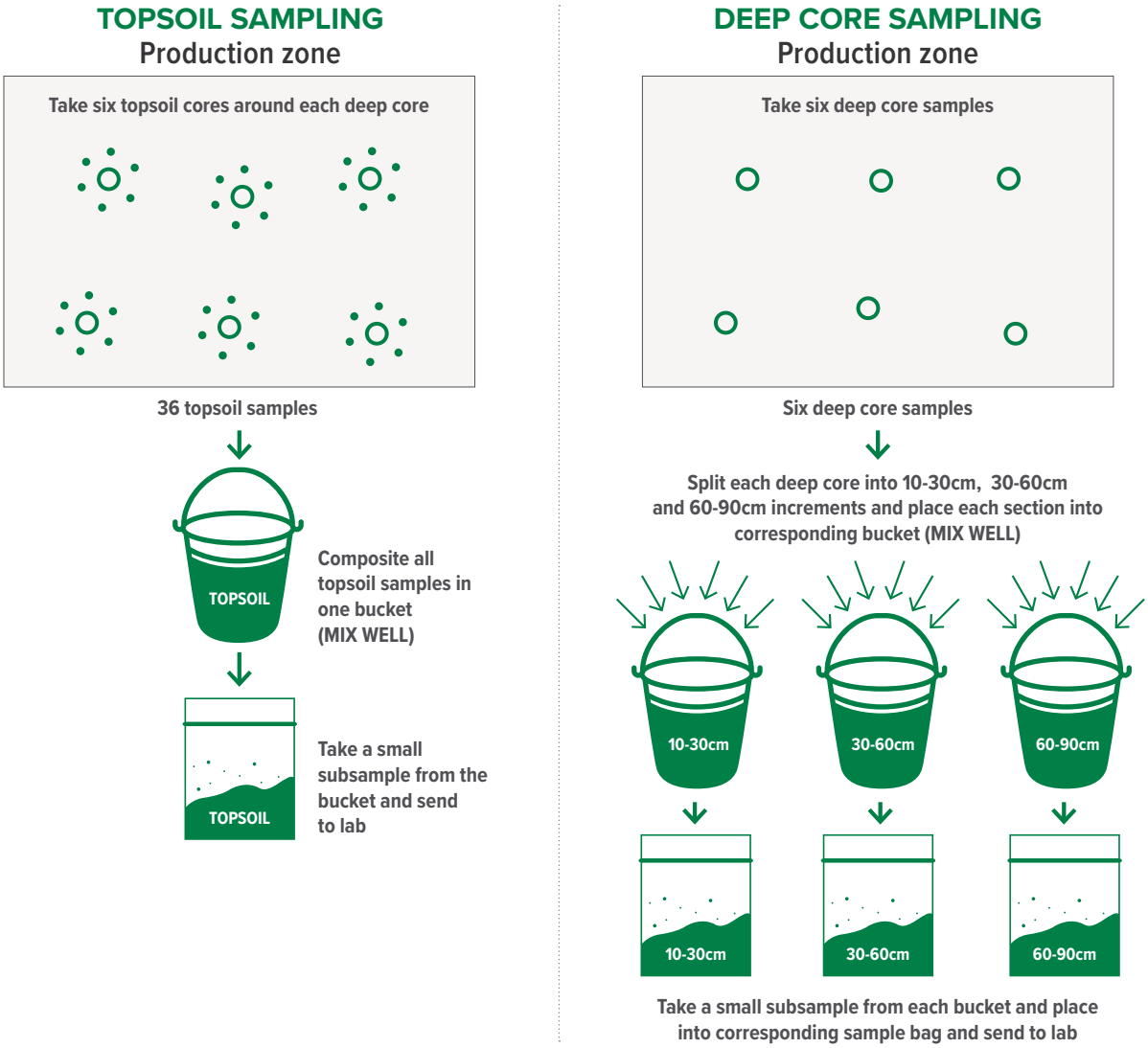
Things to avoid when sampling

Avoid areas which may have abnormal soil nutrient levels and are not representative of the production zone, including headlands, watering troughs, old fertiliser dumps, beneath trees, fencelines, roads, tracks and stock camps.

Do not place samples in metal containers as this may contaminate the sample's micronutrient levels.

Do not sample in very wet conditions and use clean equipment and sample storage bags.

FIGURE 1. Collecting soil samples



Using the results from pre-season soil testing

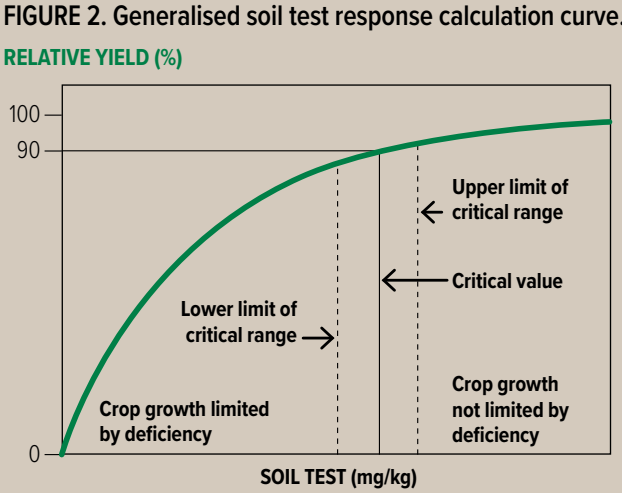
Each nutrient analysed in a soil test has a critical value required to achieve 90 per cent of crop yield potential (Figure 2).

These values have been derived from fertiliser rate trials. The critical range around that critical value indicates the reliability of that single value.

If the soil test value is less than the lower limit of the range, the crop is highly likely to respond to an application of the nutrient and the difference can be used to predict how much fertiliser should be applied. For soil values within the range or above, there is a low chance the crop will respond if additional nutrient is applied.

With support from their agronomists, growers must decide on the costs and benefits associated with adding fertiliser prior to or during the season.

FIGURE 2. Generalised soil test response calculation curve.



A generalised soil test–crop response relationship defining the relationship between soil test value and per cent grain yield expected. A critical value and critical range are defined from this relationship. The relative yield is the unfertilised yield divided by maximum yield, expressed as a percentage. Normally 90 per cent of maximum yield is used to define the critical value but critical values and ranges at 80 per cent and 95 per cent of maximum yield can also be produced. SOURCE: DAFWA AND MURDOCH UNIVERSITY

USEFUL RESOURCES & REFERENCES

Fertiliser Australia - a guide for fit for purpose soil sampling
https://fertilizer.org.au/Portals/0/Documents/Fertcare/Fertcare%20Soil%20Sampling%20Guide.pdf?ver=2019-06-17-095413-863

Fertcare Soil Sample Guide infographic
https://fertilizer.org.au/Portals/0/Documents/Fertcare/Fertcare%20Soil%20Sampling%20Infographic.pdf?ver=2020-04-21-153804-770

Fertcare sampling guidelines webinar
https://fertilizer.org.au/Fertcare/Nutrients-And-Fertilizer-Information/Soil-Sampling

GRDC Ground Cover, 'Pre-sowing soil testing and data analysis helps establish crop nutrition budget'
https://groundcover.grdc.com.au/agronomy/soil-and-nutrition/growers-encouraged-to-take-soil-samples-before-seeding-to-underpin-fertiliser-plans

GRDC Paddock Practices:
Video series educates growers on profitable fertiliser use
https://grdc.com.au/news-and-media/news-and-media-releases/south/2020/april/paddock-practices-video-series-educates-growers-on-profitable-fertiliser-use

GRDC Soil testing for crop nutrition (Southern Region) fact sheet
https://grdc.com.au/resources-and-publications/all-publications/factsheets/2014/01/soil-testing-for-crop-nutrition-south

GRDC Tackling Soil Amelioration for Variable Soil Types handbook
https://grdc.com.au/tackling-amelioration-on-variable-soil-types/

MORE INFORMATION

Sean Mason
0422 066 635
sean@agronomysolutions.com.au

Harm van Rees
0419 325 252
harm@cropfacts.com.au

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SOIL AND PLANT TESTING STRATEGY