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# CROP NUTRITION
# FACT SHEET

GRDC
Grains Research & Development Corporation
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## NORTHERN, SOUTHERN AND WESTERN REGIONS

# BETTER FERTILISER DECISIONS FOR CROP NUTRITION

Inefficient or incorrect use of fertiliser can be a substantial, but somewhat hidden, cost in the cropping operation. Using good data to better understand your existing soil nutrient status before deciding on a fertiliser strategy can optimise expenditure on fertiliser and crop yields.

**This Fact Sheet is the first of a series of Fact Sheets to assist growers in making better fertiliser decisions.**

## KEY POINTS

- Fertilisers are a major cost of growing a crop.
- Ensure your adviser has, or is working towards, the Fertcare Accredited Adviser standard.
- Be clear on fertiliser product choice and rate and timing of application.
- Soil testing is the only quantitative nutrient information that can be used to predict yield response to nutrients.
- Soil samples should be taken before sowing so that results and recommendations are available in time to order the right fertiliser product(s).
- Develop a strategy for deep sampling of nitrogen (N) and sulphur (S). For growers with a capacity to apply N either pre-sowing or at sowing, collect samples pre-crop (during fallow) with enough time to prepare N and S budgets and secure required fertiliser requirements. For growers relying on topdressing to supply additional N, sample in-crop during early crop development (i.e. cereals – during early tillering) with sufficient time to allow timely topdressing (i.e. cereals – before GS31).
- Choose a laboratory that has the Australasian Soil and Plant Analysis Council (ASPAC) certification for the tests they offer. National Association of Testing Authorities (NATA) accreditation is also desirable.
- Regular planned sampling of paddocks (for example, every three years) allows monitoring of fertility trends over time.

PHOTO: NUTRIENT ADVANTAGE LABORATORY SERVICES

*Initial preparation involves weighing soil samples out prior to analysis.*

## Introduction

Crop production is becoming increasingly precise, but when it comes to fertiliser application, some growers often make decisions about type, time and rate based on incomplete information or a 'best guess'.

Robust fertiliser decisions can be made by checking the 'four Rs' of plant nutrition, an approach developed by the International Plant Nutrition Institute that has become the cornerstone of nutrient stewardship in many countries.

4R Plant Nutrition is built around the **right fertiliser source**, applied at the **right rate**, at the **right time**, and in the **right place** (see the 4Rs in Table 1).

The purpose of the 4Rs is to work towards economically and environmentally sustainable management of plant nutrients. If the 4Rs of nutrient management are correct, the long-term economic and environmental sustainability of the farm business will be improved.

The principles behind the 4Rs take into account the physical, chemical and biological needs of the cropping soil and look to translate this information into practical decisions.

The 4Rs will be influenced by local conditions. Changes in one of the 'Rights' will mean the others need to be considered.

**TABLE 1 The Four 'Rights' of 4R Plant Nutrition: examples of the scientific principles behind crop nutrition and how they may translate into practical decisions.**

| | The 4Rs | | | |
|---|---|---|---|---|
| | Source | Rate | Time | Place |
| Examples of scientific principles | – Ensure balanced supply of nutrients<br>– Product suits soil properties (for example, choice of MAP or DAP) | – Assess nutrient supply (for example, quantity of N or P in a fertiliser product or soil ameliorant) from all sources<br>– Assess plant demand (how much nutrient the crop requires based on target yield) | – Assess dynamics of crop uptake and soil supply (for example, N is frequently applied in-crop based on demand, but current knowledge shows that P must be applied up front)<br>– Determine timing of loss risk (for example de-nitrification, volatilisation, leaching) | – Recognise crop rooting patterns<br>– Manage spatial variability<br>– Plant access to applied nutrient<br>– Nutrient toxicities<br>– Crop choice |
| Examples of practical choices | – Commercial fertiliser<br>– Livestock manure<br>– Compost<br>– Crop residue | – Test soils for nutrients<br>– Calculate economics<br>– Balance crop removal | – Pre-plant<br>– At planting<br>– At flowering<br>– At fruiting | – Broadcast<br>– Band/drill/inject<br>– Variable-rate application<br>– Percentage seed bed utilisation |

SOURCE: 4R PLANT NUTRITION, IPNI

## Why fertilise?

Before applying fertiliser, be clear *why* you are doing so. Fertiliser strategies should not be based on habit but focused on clear production goals.

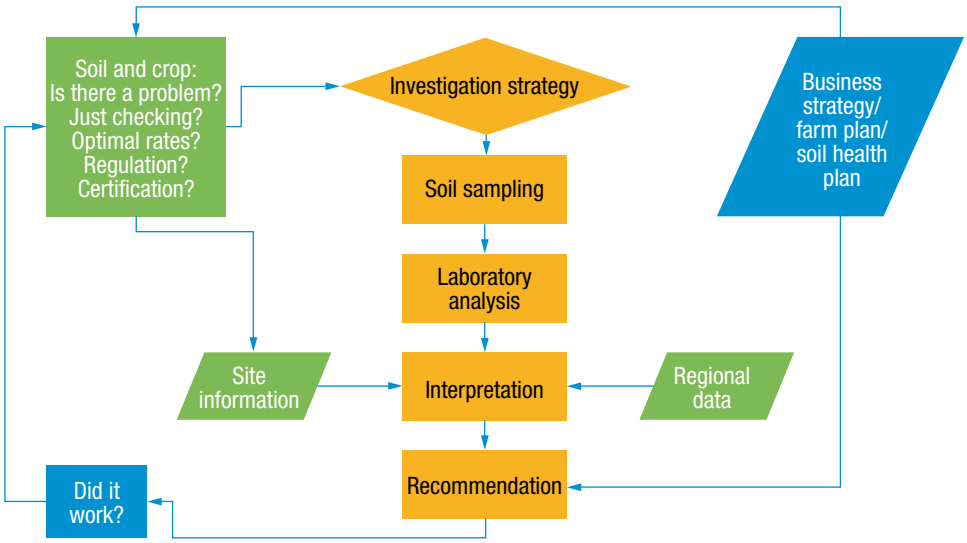
Consider strategic (end-goal) objectives, such as producing high-yielding and high-protein wheat crops, and tactical (along-the-way) objectives, such as canopy management and general risk (not committing to expense up front).

Some fertiliser decisions, such as using phosphorus, have few tactical options so the strategy needs to be set at seeding.

Selecting the right rate will be critical to meet crop demands and any requirements to build soil fertility or meet losses to the soil and environment.

Fertiliser decisions are complex and individual growers may have different objectives. But whatever the situation, the production of grain will remove essential nutrients and draw down nutrient reserves.

**FIGURE 1 The more attention we pay to all of the activities that contribute to the nutrient management process the better the outcome we will get from soil and plant testing. Testing may not provide a useful contribution if one or more of these elements is not done well.**




Growers and advisers need to know which nutrients are in short supply and which are adequate.

Soil testing provides a measure of a nutrient in the soil according to a defined method of analysis. A soil test is a tool in the nutrient management toolbox (which should also include nutrient budgeting) that can be used for making decisions about the fertiliser source and rate needed to meet targeted crop demands.

Soil testing helps to manage in-season risk, for example, managing crop N requirements. An initial soil test that includes both N and organic matter can provide a better understanding of potential N needs throughout the season. Note: the case for this is not as strong in the western region.

The soil test should be taken as close as practical to the time the N is to be applied. In practice this means time to:

- take the samples;
- get them analysed;
- have someone make a recommendation; and
- order the product.

For winter cereals, the soil test should be from two months prior to sowing up to GS31 (for canola, up to the end of rosetting).

Where rainfall records are available soil testing can help growers and advisers understand what nutrients may have become mineralised and what could still be available, using a tool such as CliMate. (See CliMate and NBudget under Useful Resources.)

## Soil testing

Many growers are using soil testing to monitor the trends in soil fertility and potential productivity limits. Despite this, there is a view among some growers that soils tests are costly, unnecessary and/or not always reliable. However, this approach may not account for money lost through rates that are incorrect or products that are inferior or not required.

Many nutrition specialists in all grain-growing regions, but particularly in eastern Australia, feel the level of adoption of soil testing among growers is lower than what could be expected from a high-performing grains industry.

A representative soil sample analysed by a laboratory provides additional information that can assist in formulating a nutrition strategy. Choose a laboratory that has ASPAC certification for the most important tests (for example, Colwell-P, DGT-P, nitrate N, sulfate S, exchangeable cations).

Decision-support tools (commercial or public) such as CliMate and NBudget can assist in interpreting results.

Remember, soil testing is one tool in the tool kit. It is not the 'be all and end all' but it can help in making more informed decisions (See Figure 2).

## Certification and accreditation

Soil-testing laboratories are subject to several types of quality assurance in order to increase their accountability for the analytical results they provide.

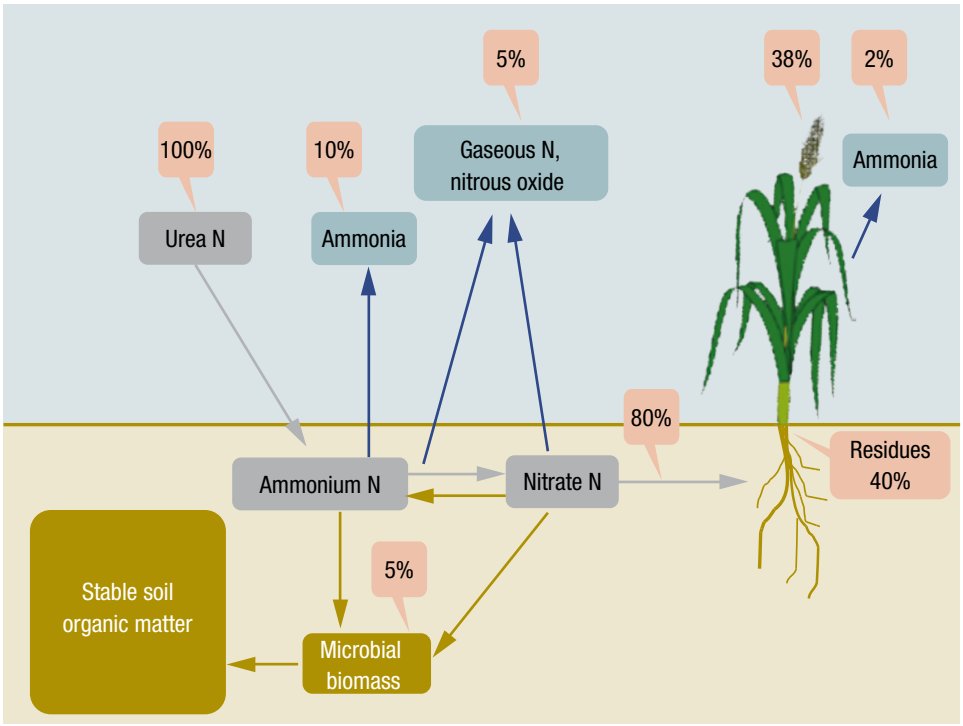
ASPAC certification is about proficiency in testing. A common set of four unknown soil samples is sent to a laboratory three times a year. The results of numerous laboratories are compared and certification for a test is only granted to a laboratory if proficiency is proven. ASPAC does not accredit or certify the laboratory. It provides certification on a year-by-year basis for specified tests.

Growers and advisers should ensure that the laboratory they are planning to use is certified to conduct the test they require, for example, Colwell-P or DGT-P.

You can find a list of certified laboratories at www.aspac-australasia.com.

NATA accreditation examines the record-keeping, processes and methodologies laboratories use to conduct soil testing.

**FIGURE 2 An example of the application and cycling of fertiliser N (in mineral form). Percentages may differ according to the cropping region.**




Fertcare is a national training and accreditation program, which is a joint venture between the Australian Fertiliser Services Association and the fertiliser industry. The program focuses on providing high-quality advice to users of fertilisers to allow them to maximise productivity and minimise environmental and food safety risk.

The Fertcare Accredited Adviser program tests the competence of advisers against national competencies and standards and provides a regular quality assurance audit program.

## Choosing a laboratory

Growers and advisers should do some research to identify a laboratory that can provide the services required.

Most laboratories are competent in conducting pH and organic carbon testing, but for tests such as Colwell-P, DGT-P, nitrate N and exchangeable cations, look for laboratories with current ASPAC certification for these tests and possibly NATA accreditation.

It is a bonus if your adviser has, or is working towards, the Fertcare Accredited Adviser standard. The Fertcare program is growing and is a standard that the grains industry overall would like to reach. Ultimately, it should provide advisers with a level of accountability for the recommendations they make.

## Soil test results

If soil test results are inconsistent with your agronomic practices, there are two questions to ask:

1. Did you sample correctly?
2. Was the laboratory certified for each of the key test results of interest?

If you and your adviser still have concerns over the result, consult the laboratory that conducted the analysis.

PHOTOS: SEAN MASON

*The DGT-P soil test is a plastic device that attracts available P to an iron oxide gel through a membrane. After 24 hours on moist soil (100 per cent water-holding capacity) the device is washed and the amount of P bound to the gel is measured.*

## Phosphorus testing

***Colwell-P*** *is a reliable soil test in most situations provided sufficient interpretive data are available.*

*All of the available fertiliser response data for the Australian grains industry has been compiled into a single database. More information is available from the Better Fertiliser Decisions for Cropping Systems in Australia website ( www.bfdc.com.au).*

***DGT-P*** *is a test showing promise and is the preferred test for calcareous soils in South Australia and western Victoria.*

## Rules of thumb

1. Choose the same test package each year (including methods), otherwise comparisons between years will be useless. For example, don't use Colwell-P for phosphorus one year, then DGT-P the next. The two tests measure different forms of available P in the soil.
2. If you do not use a standard approach to sampling, a comparison of the data between different tests will not be reliable. Aim for data that have the best chance of representing the whole paddock, and mix the sample thoroughly. For monitoring, sampling needs to cover roughly the same area each time to ensure comparisons between years are meaningful. Permanent markers on fence posts to mark a sampling transect or a handheld GPS will serve this purpose.

Soil testing laboratories should be able to provide information on appropriate soil sampling and sample-handling protocols for specific industries and crop types. Refer to the Australian Soil Fertility Manual (see Useful Resources).

## Balancing the 4Rs

It is important to avoid too much emphasis on one aspect of the 4Rs at the expense of the others. For example, rate is often overemphasised because it is a simple matter to relate it directly to input costs. However, source, time and place may hold more opportunity for improving crop performance.

If any one aspect is wrong, the ability of the other three to contribute to crop performance is compromised. Equal attention should be paid to all four.

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NSW GOVERNMENT Department of Primary Industries

IPNI International Plant Nutrition Institute

4 nutrient stewardship


## USEFUL RESOURCES

**ASPAC**
www.aspac-australasia.com

**Find a laboratory with comprehensive ASPAC certification:**
www.aspac-australasia.com/index.php/component/labproficiency

**Australian Soil Fertility Manual**
www.publish.csiro.au/pid/5338.htm

**Interpreting soil test results: what the numbers mean**
www.publish.csiro.au/pid/5352.htm

**Plant Analysis: an interpretation manual**
www.publish.csiro.au/pid/437.htm

**Soil Analysis: an interpretation manual**
www.publish.csiro.au/pid/1998.htm

**Better Fertiliser Decisions for Cropping Systems in Australia**
www.bfdc.com.au

**Fertcare® accreditation**
www.fertilizer.org.au

**IPNI 4R Nutrient Stewardship Portal**
www.ipni.net/4R

**CliMate – app for iPad and iPhone**
www.grdc.com.au/CliMate-app

**NBudget**
http://cropmate.agriculture.nsw.gov.au/

**SoilMapp**
www.csiro.au/soilmapp

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