



SOIL TEST INTERPRETATION

NITROGEN AND PHOSPHOROUS

SOIL TEST INTERPRETATION

NITROGEN AND PHOSPHOROUS

A soil test provides an indication of soil nutrients that are potentially available to the crop at the time of testing, which is generally conducted before sowing. Soil test depth is usually to 10cm, additional depths can also be sampled to represent the potential rooting zone and nitrogen distribution, although actual crop access to nutrients depends on seasonal conditions, crop type and subsoil constraints.

Soil samples are often segmented to show nutrient distribution through the soil profile:

- Topsoil: 0-10cm
- 10-40cm
- 40-70cm
- 70-100cm

CONVERTING LAB ANALYSES FROM MG/KG TO KG/HA

Most soil test results are reported as a weight of nutrient per weight of soil such as **mg/kg** or **ppm**. For fertiliser decisions, results are more useful when expressed as kg/ha, which represents the total nutrient available in the paddock.

Conversion to kg/ha requires the bulk density of a soil, which usually ranges from 1.0 to 1.6 g/cm³ and the sampling depth (cm).

Conversion formula: $\text{kg/ha} = \text{mg/kg} \times \text{bulk density} \times (\text{depth(cm)}/10)$

Example: Soil A has a bulk density of 1.0 g/cm³, while soil B has a bulk density of 1.2 g/cm³. Both have a lab result of 10mg/kg nutrient and are sampled to a depth of 10cm. The worked example of this formula is presented below.

Soil A: $10 \times 1.0 \times (10/10) = 10\text{kg/ha}$

Soil B: $10 \times 1.2 \times (10/10) = 12\text{kg/ha}$

Although both soils have the same concentration (mg/kg), here is more nutrient per hectare in soil B because it has a greater weight of soil per unit volume.

NITROGEN

Nitrogen is usually reported as:

- Nitrate nitrogen (NO₃-N) in mg/kg or ppm which typically makes up the largest proportion of nitrogen in the soil and is the most plant available form.
- Ammonium nitrogen (NH₄-N) in mg/kg or ppm can also be used by plants but the amount of this form can change if there is a delay from the time the soil is sampled to when it reaches the laboratory and/or if the soil sample is not kept cool.
- Note: Soil tests provide a snapshot of available nitrogen at sampling, but do not account for nitrogen mineralised during the growing season or losses due to leaching or denitrification.

SOIL TEST INTERPRETATION

NITROGEN AND PHOSPHOROUS

$$\text{Soil N (kg/ha)} = (\text{Nitrate (mg/kg)} + \text{Ammonium (mg/kg)}) \times \text{bulk density (g/cm}^3) \times (\text{depth (cm)}/10)$$

Example: A 0-60cm sample from a self-mulching clay is returned with a soil nitrate of 6.9mg/kg and ammonium of 1.2mg/kg. Bulk density of 1.4g/cm³.

$$\text{Soil N (kg/ha)} = (6.9 + 1.2) \times 1.4 \times (60/10) = 68\text{kgN/ha}$$

If the soil test is broken up into different layers at the time of sampling, the total N needs to be calculated for each layer using the same method as above.

Table 1. Calculating soil N status at depth intervals

Depth interval (cm)	Layer thickness (cm)	Bulk density (g/cm ³)	Soil Nitrate-N (mg/kg)	Available nitrogen (kg/ha)
	a	b	c	c x b x a/10
0-10	10	1.3	21	27.3
10-40	30	1.4	5	21
40-70	30	1.4	2	8.4
70-100	30	1.45	1	4.4
Total soil N				61 kg/ha

SOIL TEST INTERPRETATION

NITROGEN AND PHOSPHOROUS

PHOSPHOROUS

In soil tests, soil P status can be reported as Colwell P (mg/kg). Colwell P (mg/kg) measures plant available phosphorus, including soil solution P and a portion of sorbed P. Colwell P should always be interpreted alongside Phosphorus Buffer Index (PBI).

PBI is a measure of a soil's ability to fix phosphorous:

- A high PBI soil will quickly bind up P and make it unavailable for the plant.
- A low PBI soil will have more plant-available P.
- Soils with a high PBI will generally require regular and/or higher fertiliser rates to compensate for the P that becomes more rapidly unavailable.

Table 2. PBI ranges categorised according to P fixation capacity.

P buffer capacity category	PBI value
Limited P fixation	0-15
Small P fixation	20-70
Moderate P fixation	70-100
High P fixation	>100

An alternative soil test for P is Diffuse Gradients in Thin Films (DGT). Across a range of soil types in southern Australia, DGT has proven to be an accurate alternative soil test to Colwell P/PBI in predicting a crop response to P on soils with moderate to high P fixation potential. Frequency and distribution of high PBI soils on your farm will assist in determining which soil test to use. The test is generally more expensive, and potentially there could be a longer history of Colwell P/PBI soil test results on your farm, enabling a longer-term analysis of potential changes using that test. Consider using a combination Colwell P + PBI + DGT tests to see which one works for your soil types

Phosphorus DGT is measured in $\mu\text{g/L}$ and critical ranges for corresponding crop type are presented in table 3. The critical range provides a threshold where soil test results below this range suggests a high probability (95% confidence interval) of yield response to fertiliser, while levels above it indicate a low probability of economic return.

SOIL TEST INTERPRETATION

NITROGEN AND PHOSPHOROUS

Table 3. DGT ranges

Crop type	Critical range ($\mu\text{g/L}$)
Wheat	63-81
Barley	54-87
Canola	24-46
Field Pea	26-84
Chickpeas	30-98
Lentils	30

HOW MUCH P TO APPLY?

Calculating P fertiliser is best done with an understanding of soil test results, the paddock history both in terms of crop rotation, historical fertiliser application and inherent soil properties.

Table 4.

Crop	Phosphorus removed per tonne (kg P/t ha)
Cereal hay	2
Cereals	2 to 3
Cereal straw	1
Pulses	6
Canola	9

For example, a 3.5t/ha wheat crop removes 14kg P/ha. If fertiliser applied is less than removal, soil P reserves will decline over time.

Compiled by Louisa Ferrier, James Nuttall, Alicia Gault, Grace Hosking and Claudia Cox (BCG), Sean Mason (Agronomy Solutions)