Interpreting soil test results

Conducting soil tests pre-season can be useful to adjust fertiliser rates and understand other constraints to crop performance, like pH or sodicity. Samples are usually collected in summer/autumn, although it is best to test for nitrogen at depth as close to seeding as possible to more accurately estimate nitrogen availability to the crop as it is influenced with rain and mineralisation. Understanding thresholds of various different nutrients and constraints helps to guide decisions about when to take action. Reach out to one of our consultants to discuss results and possible remedies.

DEEP SOIL TESTS (0-60CM)

Deep soil nitrogen (kg/ha)

This figure gives an indication of the nitrogen (N) available to plants to the depth of sampling (usually 60cm). As a general rule, 40kg/ha of nitrogen is required to produce 1t/ha of wheat at 11% protein. The deep N result can be used to estimate the amount of nitrogen fertiliser required to achieve a target crop yield.

For example, for a paddock with a deep soil N result of 80kg/ha, to target a 3t/ha wheat crop, 120kg of N (3 x 40kg) is required by the crop. With 80kg of soil N, an additional 40kg of fertiliser N is required to achieve the 3t/ha target yield.

There are additional formulas, rules of thumb and models to refine the estimation of fertiliser nitrogen requirements for crops. These may account for mineralisation of N from organic matter during the growing season and calculate requirements for different crop types (e.g. barley, canola). Contact your agronomist for further guidance.

Deep soil sulphur (kg/ha)

Given that sulphur can be accessed deeper in the soil profile by plants, a deep soil sulphur test is a better indicator of background soil sulphur levels than a 0–10cm sulphur test. As a general indicator, 30kg or more of sulphur in the 0–60cm zone is sufficient for cereals, whilst above 50kg of sulphur is required for canola.

TOPSOIL TESTS (0-10CM)

pH

pH is a measure of a soil's acidity or alkalinity. Strongly alkaline or acidic soils 'tie up' certain nutrients. Crops and pastures vary in their preferred pH ranges and tolerances to extremes of pH. A low soil pH (acidic) can indicate a need to apply lime to optimise production of certain crops and pastures.

Two measures of soil pH are quoted in soil tests: pH in calcium chloride (CaCl2) and pH in water (H2O). The pH CaCl2 test is considered more reliable and varies less through the season while the pH water test readings can be influenced by soil moisture more than pH CaCl2. The pH CaCl2 reading will generally be 0.7–1.2 units lower that pH water hence the desired levels differ between tests.

General desired levels
pH (water) 6.0–8.5 (6.0–7.0, ideal)
pH (CaCl2) 5.5–7.5 (5.5–6.5, ideal)

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Phosphorus Buffering Index (PBI)

PBI is a measurement of a soil's ability to tie up soil phosphorus (P) and is used in conjunction with the Colwell P test to estimate plant available phosphorus. It is measured on a scale from 1 to 1000.

The higher the PBI, the more P is tied up in the soil. In general, levels above 150 indicate significant tie up of P in the soil. Values below 100 indicate that P tie up is minimal. High PBI readings are mostly associated with calcareous soils or those high in iron.

Colwell phosphorus (mg/kg)

This measure gives an indication of the 'extractable' phosphorus in the soil. It loosely indicates P availability. Generally, a value above 30mg/kg indicates the soil has adequate P levels.

However, it is important to consider the PBI of the soil when interpreting Colwell P results. A high PBI together with a Colwell P above 30mg/kg may still indicate your soil requires higher rates of phosphorus fertiliser. Soils high in free lime or iron 'lock up' a significant proportion of soil P, which can reduce the accuracy of this test in predicting soil responsiveness to applied P.

If your PBI reading is high, consult your agronomist before adjusting fertiliser rates based on your Colwell P result.

DGT phosphorus (µg/L)

The DGT phosphorus test (Diffusive Gradients in Thin Films) is a relatively new method for measuring soil P levels. It has greater accuracy in measuring available soil phosphorus than the Colwell P and PBI tests and it is not affected by soil type.

The test extracts phosphorus from the soil sample, similar to the way plant roots would. Marginal to low DGT values indicate higher application rates of P fertiliser are required. Soils with levels in the adequate range or above should only require maintenance levels of P fertiliser.

Colwell potassium (mg/kg)

This figure gives an indication of the available potassium (K) in the soil. Figures above 250mg/kg are considered high. Levels below 100mg/kg indicate potential deficiency, although this is under review on heavy soil types.

Organic carbon (%)

Organic carbon (OC) is a measure of organic matter in the soil. Soils low in OC generally have poor soil structure and hold less nutrients than a high OC soil. It is difficult to change the level of OC in the soil. For intensively cropped soils, OC levels above 1.5% are desirable.

Electrical conductivity (dS/m)

Electrical conductivity (EC) is an indirect measure of salinity in the soil. Different crops have different tolerances to salinity. Soils with EC above 1.5 are considered to be high in soluble salts, with potential limitations to production of some crops and pastures.

Exchangeable Sodium % (ESP)

Exchangeable cations are often shown on soil test results, with ESP (exchangeable sodium percentage) being an indicator of soil sodicity. A soil with an ESP reading greater than 6% is classified as sodic. Sodic soils are dispersive in nature, have poor surface structure and are likely to respond to gypsum applications.

TOPSOIL TEST INTERPRETATION LEVELS

TEST	UNIT	OPTIMUM RANGE	
pH ($CaCl_2$)	pH	Acidic	<5.5
		Neutral	5.5-7.5
		Alkaline	>7.5
Phosphorus Buffering Index (PBI)	Range 1-1000	Desired	<80
		Moderate	80-140
		High	>140
Colwell phosphorus	mg/kg	Low	<25
		Adequate	25-35
		Excellent	>35
DGT phosphorus (optimum range is shown for wheat)	µg/L	Low	<45
		Marginal	45-57
		Adequate	57-100
		High	>100
Colwell potassium	mg/kg	Low	<100
		Adequate	100-250
		Excellent	>250
Organic carbon	%	Low	<1.5
		Marginal	1.5-2.5
		Excellent	>2.5
Electrical conductivity	dS/m	Desirable	<0.75
		Moderate	0.75-1.5
		High	>1.5
Exchangeable Sodium % (ESP)	%	Non sodic	<6
		Sodic	6-15
		Strongly sodic	>15

NUTRIENT REMOVAL PER TONNE OF GRAIN HARVESTED

Nutrients are removed from the paddock each time grain or hay is harvested. To counter this removal and prevent depletion of soil nutrients, the nutrients need to be replaced via fertiliser or other amendments. This is particularly important when the soil nutrient reserves are low or the availability is too low to meet crop growth requirements.

	MAJOR NUTRIENT REMOVAL (kg/t)						TRACE ELEMENTS REMOVAL (g/t)		
CROP	**N**	**P**	**K**	**S**	**Ca**	**Mg**	**Cu**	**Zn**	**Mn**
Wheat	20	3.0	4.0	2.0	0.3	1.5	7	16	40
Barley	18	2.5	3.5	2.0	0.3	2.0	8	19	15
Oats	18	2.5	3.5	2.0	1.0	2.0	8	16	46
Canola	30	6.0	9.0	10.0	4.0	3.5	8	43	27
Lupins	50	3.0	8.0	3.0	2.5	2.0	8	32	16
Peas	40	3.5	9.0	2.0	0.8	2.0	8	26	12
Beans	40	4.0	9.5	1.5	1.2	1.0	10	28	30
Chickpeas	33	3.2	8.5	2.0	1.5	1.5	7	34	28
Lentils	40	3.9	8.0	1.8	0.7	0.9	7	28	14