AGVITA ANALYTICAL

USERS GUIDE

for the

report

July, 2018

INTRODUCTION:

AgVita has been conducting expressSoil© analyses since the mid 1990's, being a pioneer of this method of soil analysis in Australia. This test has gained wide use and acceptance in the horticulture segments of Australian agriculture, and an increasing share of the broadacre market.

ExpressSoil has many advantages over more traditional methods of soil analysis, not least of which is the rapid turn-around time. ExpressSoil uses the Mehlich-3 extraction solution for all macro and micro nutrients, a process that differs from other providers due to this alternative chemistry.

Due to the nature of this Mehlich-3 extraction solution, results for individual analytes will sometimes appear different to results received from other providers who use alternative methods of analysis. This document is designed to help users understand what the information in their expressSoil report is telling them, and how to relate this to their soil nutrient status.

The fundamental principle behind expressSoil, and indeed all soil test methods, is to give the end user an accurate representation of the plant-available fraction of a particular suite of nutrients in the soil submitted for analysis. We at AgVita feel the expressSoil test is ideal for this purpose in any agricultural enterprise across Australia.

EXECUTIVE SUMMARY:

- All tests use ASPAC accredited methods unless stated otherwise.
- The report is not crop specific or region specific – 3 generic optimal levels are automatically selected based on soil CEC
- ExpressSoil Phosphorus results are derived from a Mehlich-3 extraction, and are not directly comparable to Olsen-P, Colwell-P or other methods of P analysis.
- All other macro nutrients (Ca, Mg, K, S, Na) and micro nutrients (Cu, Fe, B, Mn and Zn) in an expressSoil report are also digested by the Mehlich-3 method.
- Total Nitrogen/Total Carbon is measured by a furnace method of complete combustion. It is not the same as organic carbon (OC) or plant available nitrate
- pH & EC is done by the same technique as most other labs
- CEC includes Al + H (exchangeable acidity) when pH <7
- Lime requirement is calculated for soils with pH <6
- Aluminium *saturation* (a calculation) is reported, not *exchangeable* Aluminium
- The kilograms per Hectare nutrient graphs on page 2 of the report take in to account a % uptake efficiency and also a % root accessibility factor when displaying the measured level

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eXpressSoil®

Client Details

Client:	EXAMPLE CLIENT	**Date received:**	12/02/2018
Grower:	Example Grower	**Current Paddock:**	BLOCK A (Sampled: 12/02/2018)
Order No.:	2016-156	**Date reported:**	17/02/18
Sample ID:	18004415	**Profile sampled (cm):**	30
Lab code:	ES25	**Client agronomist:**	EXAMPLE AGRONOMIST
Crop:	POTATO	**Soil Type:**	Heavy Soil (CEC >12meq)

N-Check Results

NO3-N:	10.90ppm	**Nitrate:**	97.2 kg/ha	**Total available NO3 + NH4:**	**98.3 kg/ha**
NH4-N:	0.12ppm	**Ammonium:**	1.0 kg/ha	Total req. NO3 + NH4 (kg/ha):	
				Total available NITROGEN =	**22.8 kg/ha**
Bulk Density:	1.07g/cm	**Rootzone Moisture**	33 mm	**% Moisture:**	10.20% W/W

expressSoil Results

Analyte	Units	Result	Optimal Range	Status
pH (H_2O)*	(pH)	7.10	6 - 7	Alkaline
pH ($CaCl_2$)*	(pH)	6.51	5.2 - 6.5	Alkaline
EC*	dS/m	0.17	0 - 0.15	High
Lime requirement	t/ha			
ESI	units	0.049	value >0.05	Low
Total Carbon*	%	0.803		
Total Nitrogen*	%	0.072		
Carbon:Nitrogen Ratio	(ratio)	11.134		
Organic Matter	%	1.236	3.25 - 5.2	Very Low
MB PSR	(ratio)	0.44	0.06 - 0.23	Very High
Mehlich Phosphorus*	ppm	103.0	40 - 90	High
Potassium*	ppm	217.9	245 - 400	Low
Sulphur*	ppm	23.9	12 - 45	Satisfactory
Calcium*	ppm	2127	1950 - 3450	Satisfactory
Magnesium*	ppm	356.7	220 - 440	Satisfactory
Sodium*	ppm	121.2	32 - 115	High
Chloride*	ppm	74	0 - 200	Satisfactory
Zinc*	ppm	7.11	2.2 - 11	Satisfactory
Copper*	ppm	14.82	2.5 - 10	Very High
Boron*	ppm	0.57	2.2 - 6	Very Low
Manganese*	ppm	84.6	18 - 70	High
Iron*	ppm	129.4	40 - 250	Satisfactory
CECe	meq/100g	15.458		
Calcium	meq/100g	10.6 (68.7%CEC)	9.7 - 17.2	Satisfactory
Potassium	meq/100g	0.6 (3.6%CEC)	0.6 - 1.0	Low
Magnesium	meq/100g	3.8 (24.3%CEC)	1.8 - 3.6	High
Sodium	meq/100g	0.5 (3.4%CEC)	0.1 - 0.5	High
Base Saturation	%	100	80 - 87	High
Exchangeable Acidity	meq/100g	0.0 (0.0%CEC)	13 - 20 %CEC	Very Low
Aluminium Saturation	%	0.00		
Ca:Mg Ratio	(ratio)	5.96	3 - 5	High
K:Mg Ratio	(ratio)	0.6	0.3 - 0.5	High

ASPAC

This laboratory has been awarded a Certificate of Proficiency for specific soil and plant tissue analyses by the Australasian Soil and Plant Analysis Council (ASPAC). Tests for which proficiency has been demonstrated are highlighted in this report by an * next to the analyte name.

BESTPRACTICE

ISO9001 QUALITY

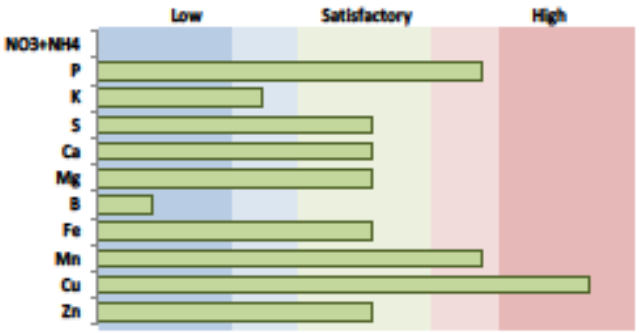
AGVITA ANALYTICAL

eXpressSoil

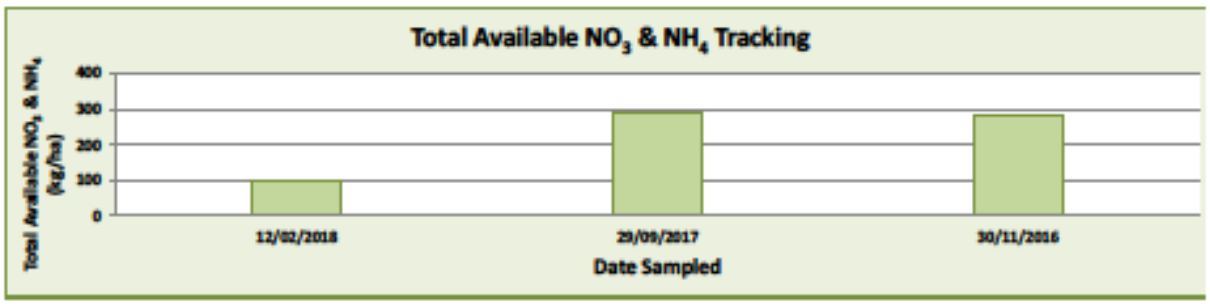
Nutrient Status and Imbalances*

BLOCK A (Sampled: 12/02/2018)

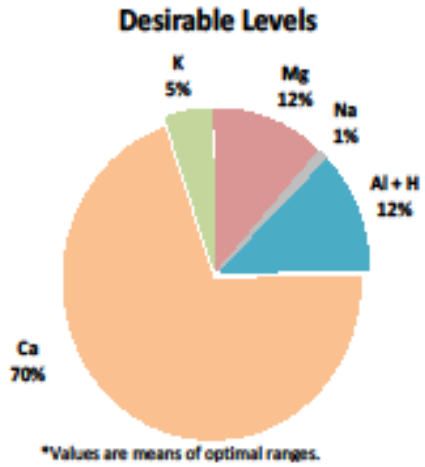
Analyte	Desired Level (kg/ha)	Measured Level (kg/ha)
NO3 + NH4		98.3
Phosphorus	43.7	69.3
Potassium	217.0	146.6
Sulphur	19.18	16.11
Calcium	1816.7	1431.3
Magnesium	222.0	240.0
Boron	2.8	0.4
Iron	97.56	87.04
Manganese	29.6	56.9
Copper	4.2	10.0
Zinc	4.4	4.8

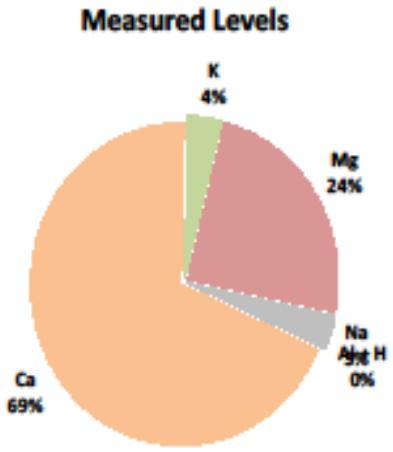


* For further explanation, please see our expressSoil Users Guide here



Soil Cation Ratio (as % CECe)





*Values are means of optimal ranges.

ASPAC

BEST PRACTICE LABORATORY ISO 9001 QUALITY

INDIVIDUAL ANALYTES AND CALCULATIONS:

The following list of explanations follows the order of these analytes and calculations on a typical complete expressSoil report. All units of measurement are displayed against analytes on our reports. All tests except for N-check are performed on dried and screened (-2mm) soil. Further details are available on our website as a series of fact sheets – see www.agvita.com.au

1. N-Check results:

This section of the report lists the analytical results and kg/Ha calculations for expressSoil samples which also include the N-Check component (eg ES23, ES24, ES25). Full details of the N-check process can be found on our website.

The key feature of this particular test is that it is performed on the **field-moist soil** (ie not dried) so the calculation to produce kg/Ha NO_3 and NH_4 takes in to account soil moisture and bulk density.

The Total Available NO_3 + NH_4 figure on the report is produced by summing the calculated kg/Ha of both NO_3 and NH_4. Please note that this figure is not the same as available NITROGEN (which is also listed) – the nitrate + ammonium figure is just that, the directly measured NO_3 and NH_4 ions whereas the total available N figure converts the NO_3 and NH_4 molecules to elemental Nitrogen.

All graphs and data lines clearly state units of measurements – either **NO_3 & NH_4**, or **N**.

2. pH (in H2O & CaCl2) and EC:

Soil pH is measured as a 1:5 soil:water mix by pH electrode and EC probe

If soil pH (H_2O) is less than 6.00, a lime requirement measurement is performed (called a buffer pH) and a calculation of t/Ha lime (at 90% NV) is reported to bring soil pH back above 6. If pH >6, this test is not completed.

3. ESI:

This is the Electrochemical Stability Index, a means of quantifying the relationship between soil sodicity and salinty. ESI is calculated as the EC divided by the exchangeable Sodium percentage (ESP), and is a measure of the risk of crusting or hard setting in the soil. A high ESI is preferred, the critical value being >0.05

4. Total Carbon, Total Nitrogen:

These two analytes are measured by a complete combustion of a sub-sample of soil by furnace method (analogous to the Dumas technique). It measures every C and N fraction in the soil – recent organic, more long-term stable humic or even charcoal fractions, fertiliser additions, even inorganic forms of C and N (eg carbonates in soils with free calcium carbonate/lime). It should not be used as a guide for plant available nitrogen.

The TC:TN ratio is important in some instances, and is a simple calculation

5. Organic Matter:

Soil organic matter is not directly measured as part of an expressSoil test. The figure reported is a calculation based on the Total Carbon figure measured above.

6. M3 PSR:

The M3-PSR (Phosphorus Saturation Ratio) is a measure of the soils ability to lock up applied or free phosphorus. It is a calculation that uses the Mehlich-3 extraction process for cations, and is essentially P divided by Fe + Al. A low PSR indicates lock-up of phosphorus, while a high PSR indicates poor retention of P and potential loss by leaching. A critical range is 0.06 – 0.23.

This calculation is designed to be used in a comparable way to a PBI value – ie in conjunction with the M3 P value to determine optimum levels of P inputs required, and the best manner of application (one large application, or small regular applications for example).

7. Phosphorus:

The most common misconception of users of expressSoil tests is the P value. AgVita uses the ASPAC accredited **Mehlich-3** extraction for the analysis of all macro and micro nutrients, most critically including PHOSPHORUS.

There is no direct correlation between an expressSoil P result and an Olsen-P or Colwell-P result. Factors such as soil pH, texture/particle size, organic matter content and other chemistry prevents this comparison.

8. Macro and Micro nutrients:

As mentioned above, AgVita uses the **Mehlich-3** extraction for the analysis of all macro (K, Ca, Mg, Na, S) and micro (Cu, Fe, Zn, Mn, B) nutrients. It is the same extraction for all nutrients. Comparisons with other digestion methods have been explored in the literature, but local correlations are needed to make meaningful deductions.

All nutrients are reported in parts per million (ppm) and macro's are also expressed in millequivelants per 100g soil.

9. Chloride:

Soil chloride is an important analyte, measured in a 1:5 soil:water mix.

10. CEC:

Soil CEC is a critical calculation of the capacity of the soil to absorb, hold and exchange positively charged nutrients in the soil solution. It is the sum (in milli-equivelants per 100g) of the four major cations, Ca, Mg, K and Na as well as the exchangeable acidity, which is Al + H (see section 11 below for further explanation).

AgVita measure CEC at the actual soil pH, so the technically correct name of this calculation is CECe, or *effective CEC*.

In general terms, a soil with a high CEC have a greater capacity to hold more nutrients than a soil with a lower CEC, and have a greater soil nutrient reserve. There is a general correlation between soil texture and CEC, with lighter sandy soils having lower CEC than heavy clay-rich soils.

11. Macros as %CEC:

The four macro nutrients described above (K, Ca, Mg and Na) are also reported in meq/100g as per convention. These values, when used in conjunction with the exchangeable acidity (see section 12 below) are further used to describe the %CEC of these macro nutrients. If the soil pH is less than 7, exchangeable acidity is also taken in to account in this calculation, whereas for pH >7, just these 4 cations are used to determine %CEC.

12. Exchangeable Acidity & Base Saturation:

These two calculations are often the cause of confusion on soil test reports. Detailed fact sheets are located on AgVita's website, but they can be summarised as follows:

The exchangeable acidity of a soil is a measure of the contribution of Aluminium and Hydrogen (Al = H) to the total cation exchange capacity of the soil. It is pH dependant to the point where above a pH of 6 this figure is small to negligible, and above a pH of 7 it is absent.

Base Saturation is the total CEC minus the exchangeable acidity (ie Al + H). It is therefore the sum of the 4 macro cations K + Ca + Mg + Na expressed as a percentage of CEC. By definition then, the sum of the exchangeable acidity and the base saturation should equal 100%.

Be careful when comparing data from soil tests analysed by different labs, as the methods for calculating these indicators can vary.

13. Aluminium Saturation:

The Mehlich-3 extraction does not provide an representative measure of plant available Al in soil. For this reason, we report a calculation called the *Aluminium Saturation* which is produced from published data describing the relationship between available Aluminium and soil pH. The value reported in an expressSoil report is not the exchangeable Aluminium of your soil. Please see our website for further reading.

14. Additional analytes:

There are several ancillary tests we can include on an expressSoil report, including Olsen-P, Colwell-P, Organic Carbon, Active (labile) Carbon, and Water Stable Aggregates (Aggregate Stability). These are clearly labelled on our reports to indicate the extraction used.

15. Lime Requirement:

AgVita uses the ASPAC accredited buffer pH method (16C1) which determines a kilogram per hectare rate of crushed ag lime ($CaCO_3$ at 90% effectiveness) to neutralise acidity to pH 6.0 to a depth of 20cm.

GRAPHICAL DISPLAYS:

There are three charts displayed on the second page of an expressSoil report (see example previous). They are as follows:

1. Nutrient Status and Imbalances:

This graph gives an excellent overview of analytical results for macro and micro nutrients in a simple chart. The values shown for the Desired Levels are derived from averages of stated optimal ranges, and Measured Levels use the actual ppm values as per page 1 of the report.

Both columns take in to account both a root access factor and an uptake efficiency factor in calculating kg/Ha figures from the raw data. Reasons behind this, and factors used in these calculations are available upon request.

2. Total Available N tracking:

This graph is only displayed for tests which include the N-check component, and is a simple display of the sum of both available NO_3 and NH_4 in kg/Ha.

3. Soil Cation Composition:

These pie graphs display the percentages of the soil CEC, both as a theoretical Desirable Range (based on the mean of the Optimal Ranges) and the actual analytical results. Exchangeable acidity (Al + H) is not displayed when the soil pH >7.

RECOMMENDATIONS PAGE:

The third page of the *Client Report* sheet is provided to allow Agronomists and Consultants to express their interpretations and recommendations to their clients. AgVita do not supply any information or opinions which may be taken as advice, recommendations or interpretations.

There is a text box for comments on the top half of this page, followed by two sections with a series of drop-down lists that allow users to select from over 250 commonly used fertilisers, logical timing and application methods with a data entry for rate of product in kg/ha.

The first of these two sections lists ameliorants and the second section is for fertiliser products. This fertiliser section also calculates the macro nutrient rates when an application rate in kg/Ha is entered and for multiple fertiliser products, and sums the macro nutrients at the end of the table as a total nutrient application.