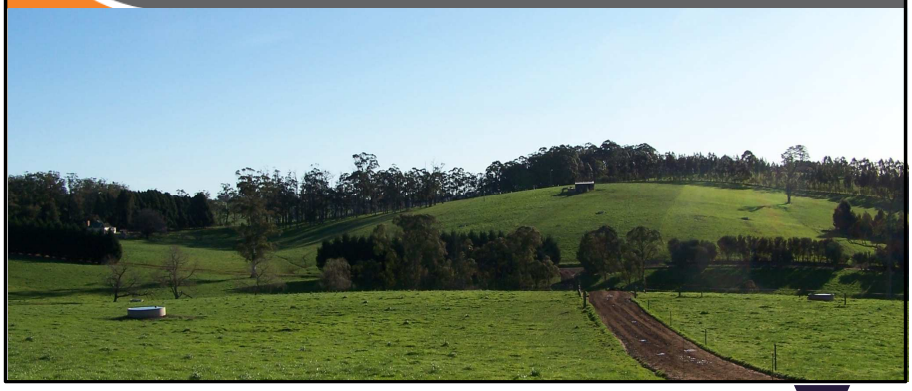
Soil tests – Understanding the figures

TopSoils Project – Phone LinkUp Presentation



VICTORIA State Government

This presentation has been developed for use during the TopSoils Phone Linkup

In the mail you should have received your soil test report and a copy of the soil test interpretation guide

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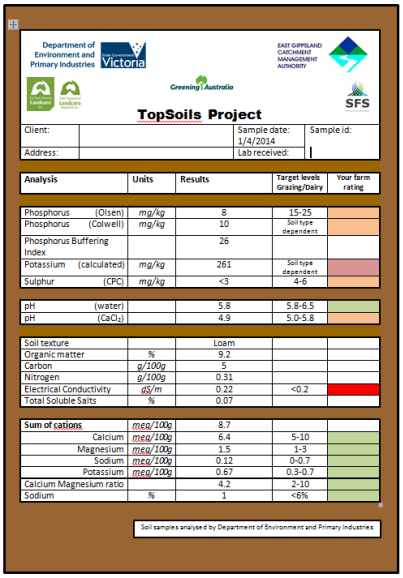
A note on the colour coding of the rating column:

- Orange = below target level. Improving level could improve pasture production and/or soil function
- Green = at target, aim to keep levels here
- Dusky red = above target levels. Opportunity to save $$ in this area. No need to apply this nutrient
- Bright Red = Dangerous levels. Attention needed to reduce levels. Implications for plant and soil health



Department of Environment and Primary Industries | Victoria | East Gippsland Catchment Management Authority | Landcare | Greening Australia | SFS

TopSoils Project

Client:		Sample date: 1/4/2014	Sample id:
Address:		Lab received:	

Analysis	Units	Results	Target levels Grazing/Dairy	Your farm rating
Phosphorus (Olsen)	mg/kg	8	15-25	
Phosphorus (Colwell)	mg/kg	10	Soil type dependent	
Phosphorus Buffering Index		26		
Potassium (calculated)	mg/kg	261	Soil type dependent	
Sulphur (CPC)	mg/kg	<3	4-6	
pH (water)		5.8	5.8-6.5	
pH ($CaCl_2$)		4.9	5.0-5.8	
Soil texture		Loam		
Organic matter	%	9.2		
Carbon	g/100g	5		
Nitrogen	g/100g	0.31		
Electrical Conductivity	dS/m	0.22	<0.2	
Total Soluble Salts	%	0.07		
Sum of cations	meq/100g	8.7		
Calcium	meq/100g	6.4	5-10	
Magnesium	meq/100g	1.5	1-3	
Sodium	meq/100g	0.12	0-0.7	
Potassium	meq/100g	0.67	0.3-0.7	
Calcium Magnesium ratio		4.2	2-10	
Sodium	%	1	<6%	

Soil samples analysed by Department of Environment and Primary Industries

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Phosphorus

- Important for early root formation and growth
- Necessary for all growth processes in the plant
- Necessary for legume nodulation and nitrogen fixation

Measured as either Olsen P or Colwell P and both measure the plant available P

Different soils have varying capacities to take up and hold (sorb) P

Colwell P – measures plant available P AND some of the less available/sorbed P

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Phosphorus Buffering Index

As P fertiliser reacts with the soil, the P becomes less available for plant uptake

The PBI is an indication of the soil's ability to take up and bind P and is used when determining appropriate Colwell P levels and for determining how much phosphorus should be applied to a soil

A soil's PBI can range from single digit figures right up to above 900.

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Phosphorus

Target Levels

Olsen P

- Native pastures: 10-12 mg/kg
- Improved pastures: 15-25 mg/kg

Colwell P

PBI Category	Target P
0-70	20 - 31 mg/kg
71-140	31 - 36 mg/kg
141-280	36 - 44 mg/kg
281-840	44 – 64 mg/kg
>840	64 – 84 mg/kg

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Potassium

Important for:

- Plant cell walls
- Flowering
- Seedset

Generally measured using either the Colwell or Skene tests. Note: available potassium was not measured on your soil sample. Your result has been calculated from the potassium result in the exchangeable cation section

Target levels are dependent on the soil type

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Potassium

Target Levels

Sands	Sandy Loam	Clay Loam	Clays	Peats
101 – 150 mg/kg	121 – 200 mg/kg	151 – 250 mg/kg	180 – 300 mg/kg	351 – 600 mg/kg

At levels below target, increases in K can result in increased productivity

At levels above target, there is a risk of K causing environmental issues when lost via leaching through the profile

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Sulphur

Important for:

- Formation of proteins and vitamins
- Chlorophyll production
- Stress resistance

Generally measured by either the CPC test or KCl 40 test.

Target levels

- CPC test 4-6 mg/kg
- KCl 40 test 8-12 mg/kg

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Soil pH

Measured as either pH (water) or pH ($CaCl_2$)

- The calcium chloride test is more useful for long-term monitoring of pH

As soils become more acidic, some elements such as aluminium and manganese can become more available – these elements can be toxic to plants. Soil life also find living conditions difficult as soils become more acidic

Target Levels

- pH(water) 5.8 – 6.5
- pH($CaCl_2$) 5.0 – 5.8

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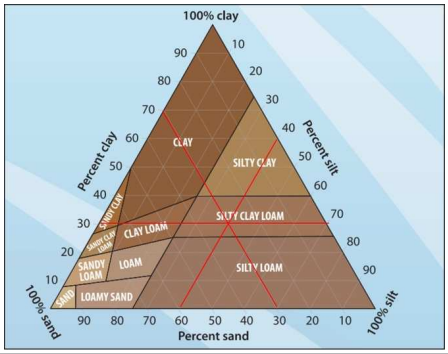
Soil texture

The texture of a soil is an indication of soil type and its properties, and is always taken into account when interpreting the other results and preparing fertiliser recommendations



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Aluminium

- Tested using the KCl test and reported in mg/kg
- < 50 mg/kg is desirable for most plant species
- Not essential for plant growth
- Toxic to plants, particularly impeding seedling growth
- Generally the more acidic a soil, the more available Al becomes in the soil solution
- Lucerne and Phalaris are highly sensitive to Al
- Sub and white clover and perennial ryegrass are moderately tolerant, cocksfoot is highly tolerant
- If the pH of your soil is = to or above pH($CaCl_2$), Al was not tested

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Soil Boron

- **Note: a plant tissue test is a better indicator of plant available Boron levels**
- Suggested adequate soil levels 1-4 mg/kg
- Boron availability appears to be heavily influenced by soil moisture
- May appear in some years and not others – mainly dry summer periods
- Signs:
  - Lucerne: yellow or purplish red terminal leaves
  - Sub clover: oldest leaves develop a bright reddish coloration along the outer margins
- Excessive liming may induce Boron deficiency
- High levels of Boron are toxic to plants

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Soil organic matter/soil carbon

- Soil organic carbon is used to estimate of the soil organic matter content.
- Organic carbon levels will vary according to the soil type, climate, pasture or crop type, farm management including stocking rate, and grazing management
- If organic carbon levels are above 3 g/100g, the soils should have good structural condition and high structural stability
- Organic matter adds and hold nutrients in the system

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Nitrogen

Note on soil nitrogen tests

- It is difficult to measure the amount of nitrogen available for plant growth in soils because the form and availability of nitrogen in the soil can change quickly
- By the time the soil samples are received and analysed by the laboratory the amount of mineral N in the sample may have changed
- By the time the soil test results are returned to the farmer changes may have already occurred in the N content of the soil.

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Electrical Conductivity

- Electrical conductivity gives an indication of the salinity status of the soil
- Generally salinity is not considered an issue if the electrical conductivity is below 0.2 dS/m

- The salt tolerance of plants is usually based on a different test, the electrical conductivity of a saturated extract
- This is called the ECe method and is also measured in deciSiemens per metre

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Electrical Conductivity

- A plant growing in saline conditions will make adjustments to cope with the increase in salt levels in the soil solution
- The ability of the plant to continue this adjustment is a measure of its tolerance to salinity

SOIL TEXTURE GROUP	MULTIPLICATION FACTOR
Sand, loamy sand, clayey sand	23
Sandy loam, fine sandy loam, light sandy clay loam	14
Loam, very fine sandy loam, silty loam, sandy clay loam	9.5
Clay loam, silty clay loam, very fine sandy clay loam, sandy clay, silty clay, light clay	8.6
Light medium clay	8.6
Medium clay	7.5
Heavy clay	5.8
Peat	4.9

Source: Adapted from Slavich and Petterson, (1993)

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Total Soluble Salts

- Total soluble salts (TSS) used to be a popular way of expressing soil salinity and is still used by a few laboratories
- As TSS cannot be easily related to plant growth, electrical conductivity and Ece are much better indicators as to the impact salinity may have in your system

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Sum of cations

- Gives an indication of the capacity of the soil to absorb and hold cations
- Varies depending on the soil type
- Cations reported
  - Calcium
  - Magnesium
  - Sodium
  - Potassium

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Exchangeable Calcium

- Should make up the largest amount of the cations in the soil
- Many soils have inadequate concentrations for a healthy soil structure
- High levels of exchangeable Ca increases flocculation and can improve soil structure in clay soils
- Target level 5-10 meq/100g

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Exchangeable Magnesium

- Exchangeable magnesium should make up the next largest amount of the cations
- Excessively high levels of magnesium can cause a potassium deficiency

- Target level 1-3 meq/100g

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Exchangeable Sodium

- Although not needed for plant growth, Na is needed by animals
- A high CEC Na value can cause crusting/dispersion in sodic clay soil with low organic carbon

- Target level 0-0.7 meq/100g

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Exchangeable Potassium

- High levels of exchangeable potassium can cause animal health issues, such as grass tetany
- High levels also pose an environmental risk due to the liklihood of leaching through the profile in wet conditions

- Target levels 0.3 – 0.7

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Calcium to Magnesium ratio

- Ratio of exchangeable calcium to exchangeable magnesium provides some guide to a soil's structure and any potential problems that might be influencing soil drainage, root development and subsequent plant growth
- Well structured soils have a calcium/magnesium ratio greater than 2
- In other words, the amount of calcium cations is more than two times greater than the amount of magnesium cations

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Calcium to Magnesium ratio

- The stability of heavier soil types (clays and clay loams) is possibly reduced where the calcium/magnesium ratio is less than 1
- A calcium-to-magnesium ratio of more than 10 indicates a potential magnesium deficiency in pasture species (this can be confirmed with a plant tissue analysis)

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Sodium %

- Exchangeable Sodium Percent (ESP), the desirable level is less than 6%
- If the exchangeable sodium is greater than 6% of the CEC, then soil structure may be affected and addition of gypsum may be required
- Sodic soils have poor structure and disperse readily when wet.
- Seedlings have difficulty penetrating a drying dispersed surface, with consequent poor germination and survival.
- Dispersion is caused by weak positive charges, such as sodium, and responds to gypsum application, which replaces the sodium ions with calcium ions.

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So what sort of results did we see across the district?

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What gets priority?

- Hard question – depends on your farm goals
- The major nutrients drive pasture production, but pastures will not respond to increasing nutrient levels if soil structure and conditions aren't adequate
- My thoughts….
  - pH, sodium %, Electrical conductivity
  - P, K and S
  - Calcium Magnesium ratio
  - Exchangeable cation levels
- Sometimes you can't change levels and must change management or accept current production levels

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