TAFCO Myrtleford - Soil Testing Workshop

Understanding the health and productivity status of your soil

The workshop will cover....

- how to read soil test results and the critical limits/target values – particularly Organic Carbon, Phosphorus, pH, Al.
- considerations for evaluating the recommendations you have been given
- using soil tests in your Soil health Management Plan

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Key messages for today

•Soil test results are only one piece of the puzzle - not 100 % of the story – your goals, the paddock condition, and soil type are also critical components

•Soil testing is an important tool for managing soil health

• **A Regular sampling regime will allow comparisons and trends – greater understanding and confidence**

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Critical success Factors

- Robust sample collection methods
- Reliable lab analysis
- Appropriate interpretation approach

Soil testing- getting it right

How? Good sampling techniques – 10cm depth and grid sampling pattern to collect 25 – 30 cores, avoiding gateways, fence lines, water troughs, stock camps and use good sample hygiene

When? Same time each year – Spring

Where? Send samples to ASPAC accredited laboratory (and ideally NATA accredited)

http://www.aspac-australasia.com

Some Important terms and concepts

- "Available" – the amount of nutrient that the plant can readily access
- "Extractable" – the amount of nutrient extracted by a specific solution to *estimate* the amount of available nutrient and/or the amount of nutrient that might become available
- "Total" – the total amount of nutrient held in the soil including the amount available
- "Exchangeable" – the amount of nutrient held on the negative surface of clays and OM

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Converting Numbers

- 1 ppm = 1mg/kg
- 1cmol (+) /kg = 1meq/100g
- 1dS/m = 1mS/cm = 1000µS/cm

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GROUP EXERCISE

Crop = wheat
Sample depth = 10 cm
P lab result = 12 mg/kg what is the status of the soil

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SOIL ORGANIC CARBON - methods

- Walkeley-Black method was widely used
- Doesn't consistently recover C
- Temperamental

- New methods are by Dumas
- Automated
- Reliable
- Measures total C

- SOC/SOM helps assess fertility and structure

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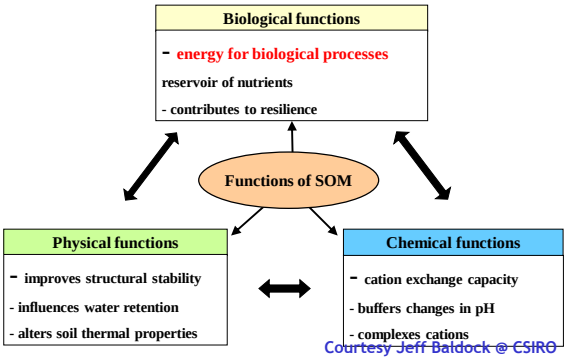
What is Soil Organic Matter (SOM)?

- It is "everything in or on the soil that is of biological origin, whether it's alive or dead"
- It includes plant roots and litter, but not shoots
- It is a very diverse collection of materials

Courtesy Graeme Schwenke @ NSW DPI

Why is Organic matter important?



Courtesy Jeff Baldock @ CSIRO

Organic Carbon

Organic Carbon Levels	Low Rainfall	High Rainfall
Low	<2%	<3.0%
Moderate	2 – 3%	3 – 6%
High	>3%	>6%

Source: DPI

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What determines the organic matter content of soil ?

- **Soil characteristics**
  - Clay content, aggregation, dispersion, soil biology
- **Climate and Environment**
  - Temperature, rainfall, soil water balances – aerobic or anaerobic systems
- **Landuse and Farm Practices**
  - Tillage type and frequency, species choice (C:N ratio), stubble handling, manure inputs etc

How to increase soil organic matter?

- Grow it
  - Grow healthy crops and pastures; Manage Grazing and stubble to maximise organic matter inputs; green / brown manures
- Spread it
  - Effluent, manures, old hay, composts
- Buy it
  - Organic amendments – above plus any processed or unprocessed organic waste, sawdust, biochar, biosolids, humates etc

Management Options

- Add it – apply inputs of OM – manures, composts, biochar, biosolids
- Grow it – grow more biomass
  - Green manure crops
  - Including grasses, perennial grasses
  - Rotational grazing
  - Ensure an adequate supply of nutrients for pasture growth

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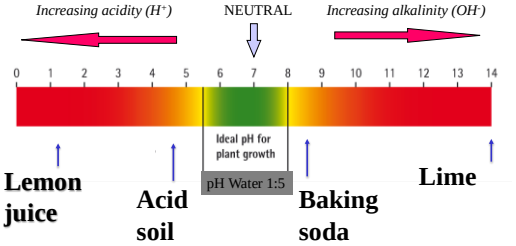
Soil pH – What is it?

pH is a measure of the concentration of hydrogen ions [H+] in the soil. The intervals between numbers on the pH scale is logarithmic, which means every number on the scale shows ten times more [H+] concentration than the number above.



Source: Constraints to cropping soils in the northern grains region-a decision tree' GRDC Northern SSC program (Qld NR&W publication)

pH - methods

- pH 1:5 soil:water is still available
- Closer to soil solution pH in winter
- Lots of data on plant sensitivity to acidity/alkalinity using this test
- Use either to assess extremes in acidity or alkalinity
- *Keep pH above 5.5*
- pH 1:5 soil:0.01 M $CaCl_2$
- Less affected by seasonal variation
- Closer to soil solution in summer
- Good test for monitoring acidification
- *Keep pH above 4.8*

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Why is pH important?

- pH influences most soil chemical processes that affect nutrient availability – particularly P, N, K, S, Ca, Mo
- pH influences the availability of toxic elements – Al
- pH influences soil microbial activity

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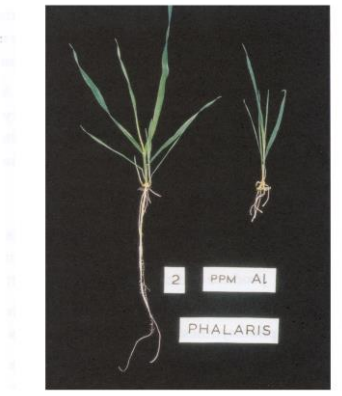
Affect of aluminium on Phalaris



Nil aluminium 2 ppm aluminium

Courtesy
Dr Jason Trompf

Aluminium (Al)

High levels of Al can be toxic to plants

- 1 M KCl extractable Al (<50 mg/kg)
- 0.01 M $CaCl_2$ (<1 mg/Kg)
- Al as % CEC (< 5%)
- Used to estimate Lime requirement
- Species and varieties vary in sensitivity
- Controlled by soil pH and mineralogy

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Management Options

- Lime application– on your most productive land
- Grow acid tolerant species
- Also need to consider:
  - Management of Nitrogen to reduce leaching
  - Monitoring pH – every 3 – 4 years
  - Including perennial pasture species

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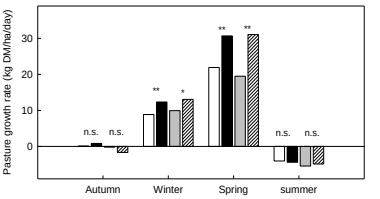
Lime and Pasture growth rate response



- Li et al (2006) AJAR Pasture accumulation rates Open bars, unlimed perennial pasture; solid bars, limed perennial pasture; grey bars, unlimed annual pasture; hash bars, limed annual pasture. *, $P < 0.10$; **, $P < 0.05$; n.s., not significant.

Earthworms in an acid Sodosol (number/m^2)			
Year	**Control**	**Lime (3.7 t/ha)**	**Least sig. Diff.**
1994	**58**	**85**	**n.s.**
1995	**84**	**89**	**n.s.**
1996	**118**	**203**	**45**
1997	**125**	**250**	**61**

Experimental site was at Book Book NSW. Limed treatments were maintained at pH 5.5 and control pH was 4.1 in CaCl2
From: White et al 2000

Phosphorus (P)

- Phosphorus is important for energy storage and transfer, early plant and root growth, and nodulation processes
- Phosphorus deficiency shows up on older Leaves dull, lacking lustre, bluish-green or purple colours. Poor growth and poor root growth
- Most soil test calibration research has been on soil P tests v. fertiliser response in wheat and pasture
- Availability controlled by soil chemistry and soil biology

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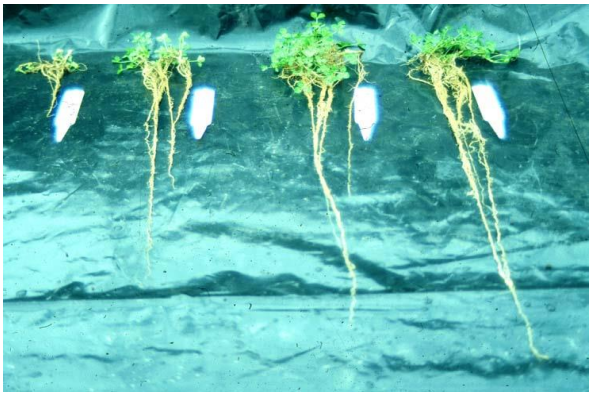


Courtesy Dr Jason Trompf

Extractable Phosphorus (P) - methods

- Colwell P
- Used widely in Australia
- PBI available to adjust critical Colwell P values
- More commonly used in crop situations

- Olsen P
- Calibrated in Victoria
- More commonly used in pasture situations

Other soil tests – less relevant

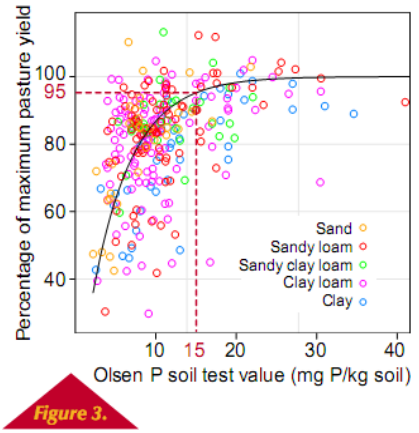
Phosphorus Use Efficiency

- Agriculture has a Phosphorus use efficiency of around 25% - that is, 4 units of P are applied as fertiliser to produce only 1 unit of P in the product
- PUE Range – 5% to 60%

Phosphorus – Olsen Critical limits

Olsen P	Target range (mg/kg)
Native pastures	<12 mg/kg
Introduced pastures -aiming for 80 – 90% potential pasture yield	10 – 14 mg/kg
- Aiming for 90 – 95% potential pasture yield	15 – 20 mg/kg

Source: DPI



Phosphorus

303 Experiments

Need an Olsen P =15 to get 95% of maximum pasture growth

source Gourley et al

Phosphorus - Colwell

Colwell P	Target range (mg/kg)
PBI category	aiming for 80 – 90% potential pasture yield
Very low (0 – 70)	18 – 30 mg/kg
Low (71 – 140)	37 – 35 mg/kg
Moderate (141 – 280)	32 – 42 mg/kg
High (281 – 840)	44 – 58 mg/kg
Very High >840	>70 mg/kg
PBI category	aiming for 90 – 95% potential pasture yield
Very low (0 – 70)	23 – 34 mg/kg
Low (71 – 140)	35 – 45 mg/kg
Moderate (141 – 280)	42 – 54 mg/kg
High (281 – 840)	58 – 75 mg/kg
Very High >840	>80 mg/kg

Source: DPI

Phosphorus Buffering Index PBI

- Phosphorus is strongly adsorbed by soil, does vary by soil type, mainly due to iron and aluminium oxides in soils
- This can limit what is available to plants
- PBI allows you to make a more accurate estimate of the amount of P required to raise available P levels in the soil.
- Target levels of P will increase with increasing PBI

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Management options

- If your goals are for high production levels then your target range will be higher
- Target your best paddocks for investment in P
- Monitor P levels over time
- Monitor and manage pH
- Rotationally graze – more even spread of P and better management of ground cover

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Extractable Potassium (K)

Potassium is important for regulating water and nutrient uptake, flowering and seed set and plant resistance to stresses

- Colwell K or Skene K test
- Exchangeable K: exchangeable cation test
- Pasture/Crop response to K has been rare in SE Australia on clay soils – except on "hay" paddocks
- Availability controlled by soil chemistry and mineralogy

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Colwell Potassium

Potassium level	sands	Sandy loams	Clay loams	Clay
low	<50	<80	<110	<120
Aiming for 80 – 90 % pasture Yield	60 - 100	70 - 110	70 - 120	80 - 120
Aiming for 90 – 95% pasture yield	90 - 130	100 - 150	100 - 150	120 - 160

Source: DPI

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Extractable Sulfur (S)

- Important for Nitrogen fixation and involved in formation of several important amino acids, proteins and vitamins
- Sulphur also vital for animal health
- KCl-40 Considered the main test
- Supply controlled by soil biology and soil chemistry

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KCl – 40 test

	Target S (mg/kg)
Aiming for 80 – 90 % potential pasture yield	6 – 7.5
Aiming for 90 – 95% potential pasture yield	7.5 - 11

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Exchangeable Cations

- Cations measured: Ca Mg K Na Al
- Ammonium acetate method: cheaper, quicker
- Reported as cmol (+)/kg or meq/100g
- Mainly used to calculate ratios eg ESP, Ca/Mg, Al%

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Steps to produce a healthy soil -

target investment to your most productive paddocks

- Address nutrient issues eg Phosphorus, potassium, Sulphur
- Correct pH and reduce aluminum using lime
- Sow the right species for the area/soil type
- Build organic matter and biological activity
- Correct grazing management – keep soil cover
- Reduce traffic on wet soil

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Important Considerations

- Farm Business Objectives and strategies
- Paddock and pasture condition and composition – target investment to your most productive paddocks
- Soil type and soil health issues
- ***Soil tests are only one piece of the puzzle***

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The Value of Soil tests

- Soil test results are only one piece of the puzzle - not 100 % of the story – your goals, the paddock condition, and soil type are also critical components
- Soil testing is an important tool for managing soil health
- **A Regular sampling regime will allow comparisons and trends – greater understanding and confidence**

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CLOSE

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