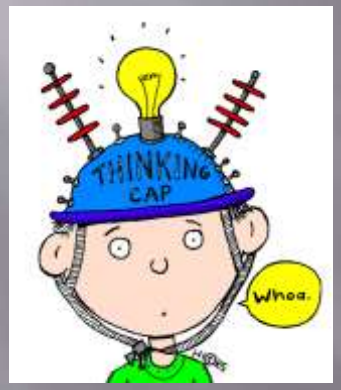
Soil tests - Help!

Stop the soil test confusion

Warrigal Beef Cheque Group and Western Port Catchment Landcare Network, 2015



wpcln
Western Port Catchment Landcare Network
Central Region

Warragul BeefCheque Group

Australian Government

Soil tests - Help!
Can I stop the confusion?

Probably not!

However at the end of the session I am confident that you will understand why there is so much confusion

Jig Saw Puzzle of Knowledge

How many pieces of the puzzle do you now have?

- Soil biology
- **Soil chemistry**
- Structure of soils
- Plant nutrition
- Soil health
- Soil carbon
- Farm ecology

Understanding Our Soil Analysis

Session

- Sustainable approach to soil fertility enhancement
- Jig saw puzzle of soil information
- Hands-on approach to understanding our soil analysis
- Discussion/questions on soil analysis

MEDIA Wrap....

SWINBURNE UNIVERSITY OF TECHNOLOGY

national centre for sustainability

News

- True Love Between Grass and Clover Leads to Richer Harvest
- Peak phosphorus inevitable
- Scared grasshoppers change soil chemistry

ABC Science

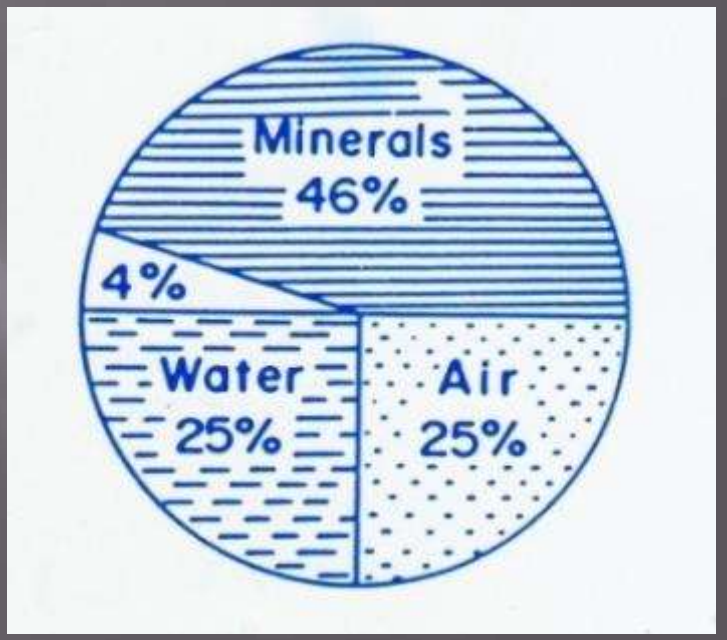
Clifton Park System of Farming
Robert Elliot - 1908

1. Success of agriculture depends on cheapening of production
2. The cheapest food for stock is grass
3. The cheapest manure for soil is turf
4. The cheapest, deepest, and best tillers of the soil are roots.

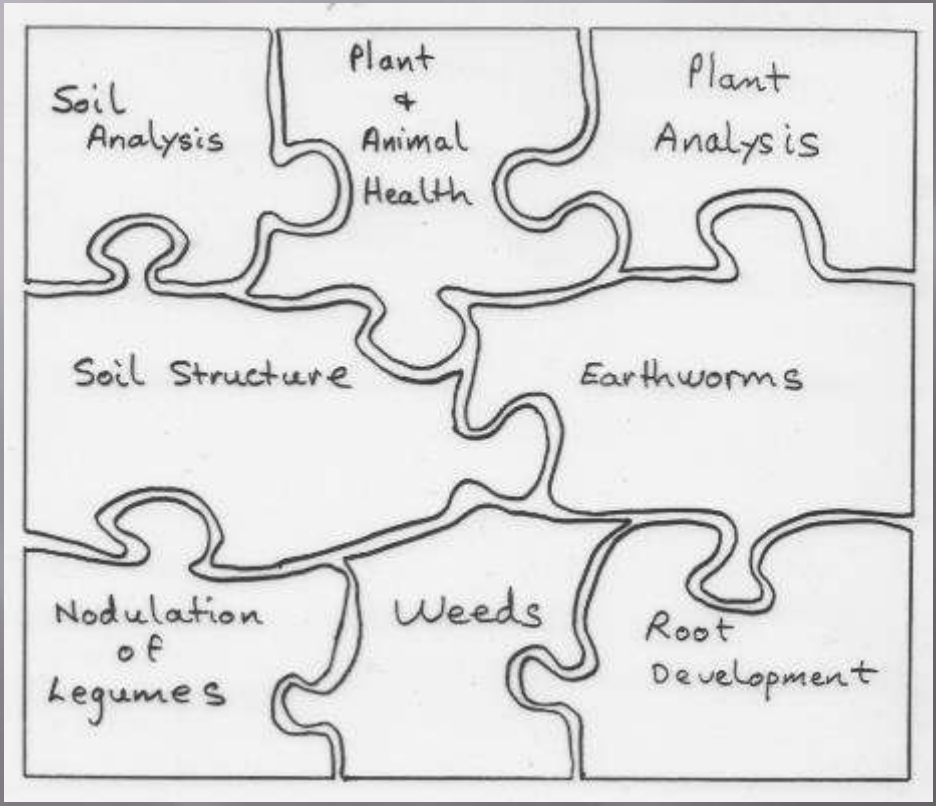
Soil Composition

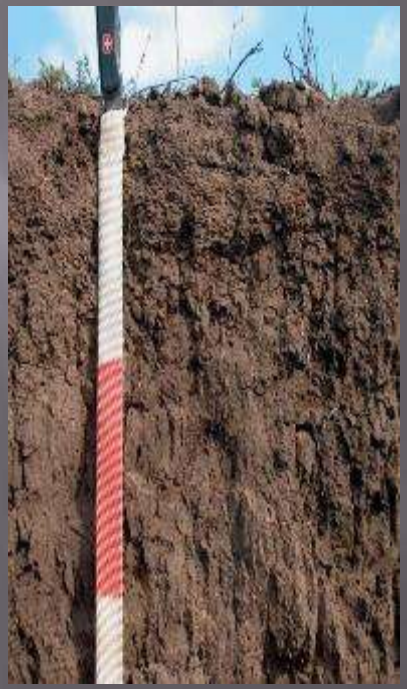
A soil is composed of three essential components:

1. **Soil minerals (chemistry)**
2. **Organic matter**
3. **Pore space (air & water)**



Assessing Soil Quality





Soil Analysis

Soil tests are a valuable tool for identifying a soil's fertility status which can be related to crop needs. The analysis usually provides a recommendation of suggested amendments.

Soil Analysis as a Tool for Sustainable Agriculture

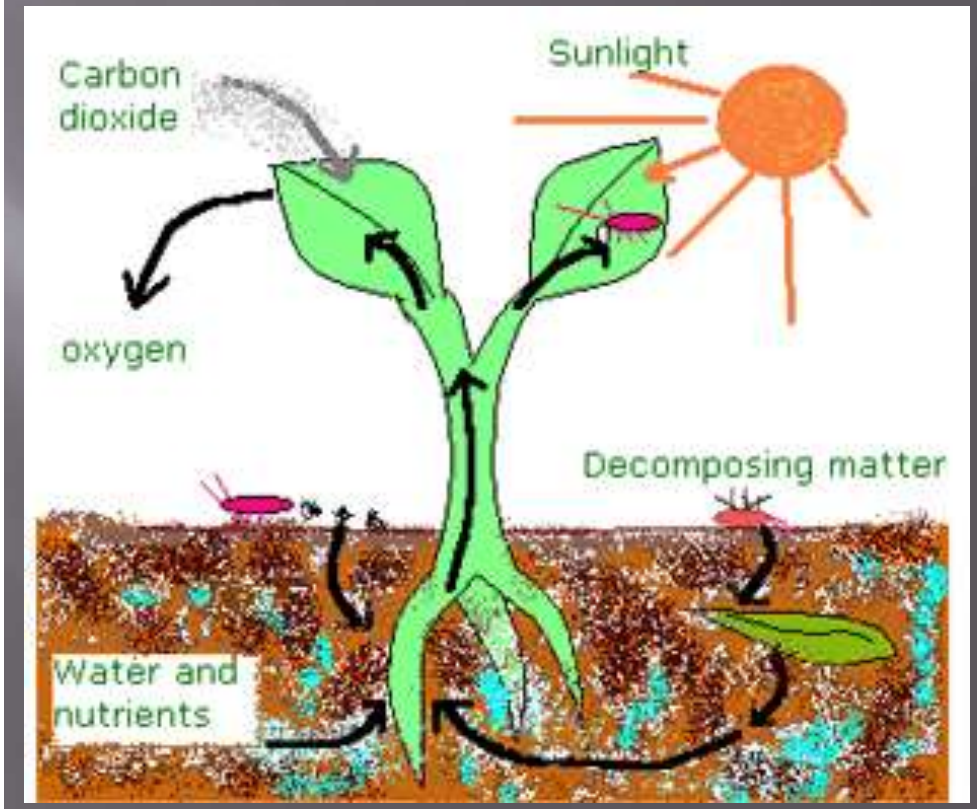
- Sustainable agriculture relies on optimising the soils inherent fertility through managing organic matter, nutrients, air and water.

- The soil analysis assists in nutrient budgeting where understanding the inputs and outputs of the system avoids the purely input approach, **and only** 'tops up' nutrients where there is a demonstrated need.

Essential Plant Nutrients

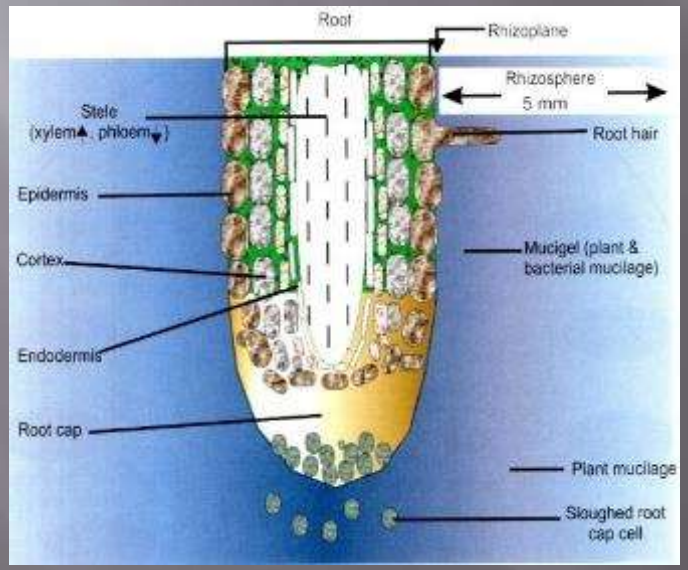
Table 1. Essential Plant Nutrients

Nutrient	Ions Absorbed by Plants
Structural elements	
Carbon, C	CO_2
Hydrogen, H	H_2O
Oxygen, O	O_2
Primary nutrients	
Nitrogen, N	NO_3^-, NH_4^+
Phosphorus, P	$H_2PO_4^-$, HPO_4^{-2}
Potassium, K	K^+
Secondary nutrients	
Calcium, Ca	Ca^{+2}
Magnesium, MG	Mg^{+2}
Sulfur, S	SO_4^{-2}
Micronutrients	
Boron, B	$H_2BO_3^-$
Chlorine, Cl	Cl^-
Ccbalt, Co	Co^{+2}
Copper, Cu	Cu^{+2}
Iron, Fe	Fe^{+2}, Fe^{+3}
Manganese, Mn	Mn^{+2}
Molybdenum, MO	MoO_4^{-2}
Zinc, Zn	Zn^{+2}



Why do analyses and recommendations from different laboratories appear to vary so much?

- **Different chemical extractants used by labs**
- **The type of instruments used to detect the nutrient in the extractant**
- **The method of reporting**



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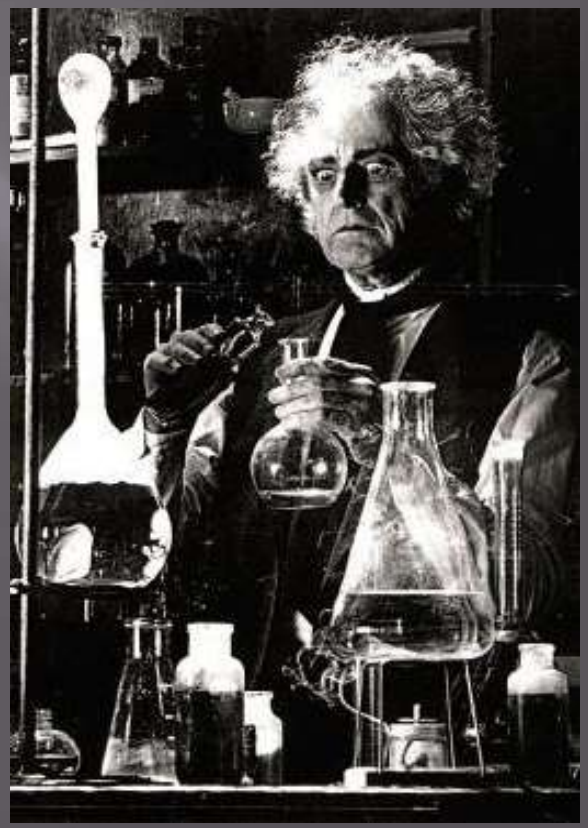


Phosphorus can be extracted using a number of methodologies

1. Bray & Kurtz P1 (The original "standard" extractant, developed for acid Midwest soils)
2. Bray & Kurtz P2 (A stronger version of P1 that identifies less soluble P, due to rock-phosphate use)
3. Olsen (Developed for high pH soils, where the Bray & Kurtz methods were thought to be weak)
4. Colwell- employs a Na HCO3 extractant ratio of. 1:100 & a 16 hour shake. Primarily estimates quantity.
5. Morgan (Developed in the Northeast States as a more "universal" extractant for acid soil)
6. Modified Morgan (An improvement, to include micronutrient analysis)
7. Mehlich 1 (Developed for the acid, low CEC Southeast soils)
8. Mehlich 3 (A modification of Mehlich 1 for higher CEC, Midwest soils)

Introduction to a Soil Analysis

Reliability Issues

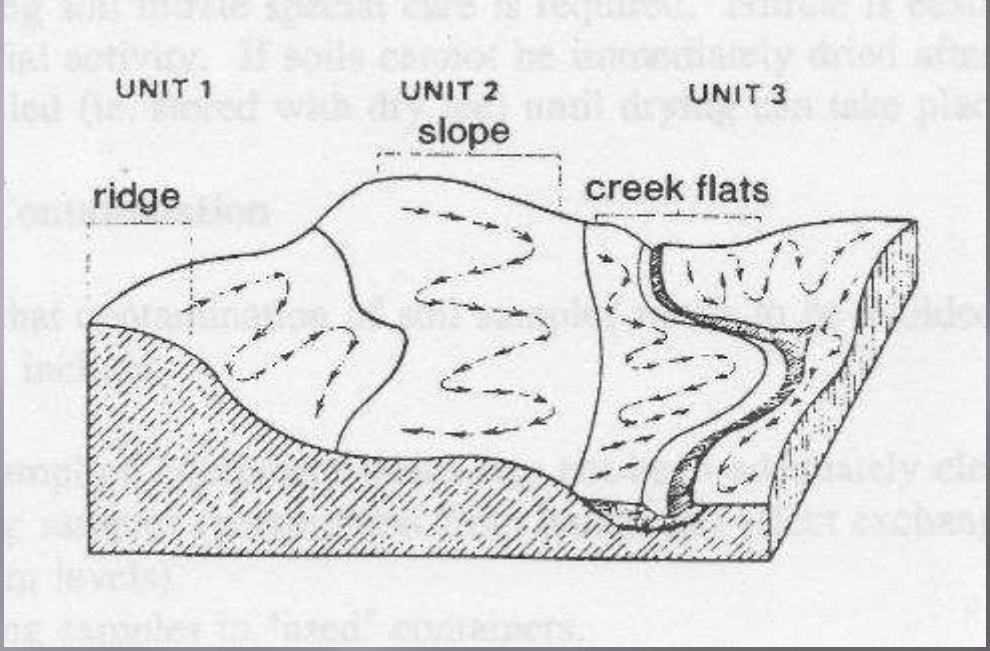
- Insufficient samples are taken and are not representative of the area sampled ****
- Plant debris may have been included in the sample.
- Soils sampled are contaminated by soil amendments or fertilisers resulting in misleading soil test results and incorrect recommendations.
- Time of sampling
- Laboratory variation

How Well Was Your Soil sampled?

It is probable that a teaspoon of soil in the lab will represent about 10,000 tons of soil from a ten acre field!

Soil Analysis - Sampling

Sample Collection



Suggested sampling patterns indicated by arrows, for three different topographical units (Vimpany et al, 1985)

Avoid

-fields of differing fertiliser treatments

-areas of built –up animal manures

-differing soil types

-the greater the number of samples taken the more reliable the results

- grid sampling is preferable

Introduction to a Soil Analysis

A standard soil test report should provide information on:

- Soil type.
- Soil pH.
- Organic matter/Organic carbon.
- Available nitrogen and total nitrogen (an additional suggested analysis)
- Available phosphorus (P) and total phosphorus(an additional suggested analysis)
- Available potassium (K).
- Available sulphur (S).
- Trace elements -boron, manganese, iron, molybdenum, zinc
- Cation exchange capacity (CEC).
- Exchangeable nutrients
- Soil salinity: electrical conductivity (EC) and salt level (% Na).
- Recommendations for fertiliser application (if requested).

Units of Measurement

Soil test results for nutrients are usually expressed as:

mg/kg (milligrams per kilogram), =

ppm (parts per million), =

µg/g (micrograms per gram).

Organic matter, carbon, exchangeable nutrients expressed as a %age.

Examine soil analysis and confirm which measurements are used.

Soil Testing Methodologies

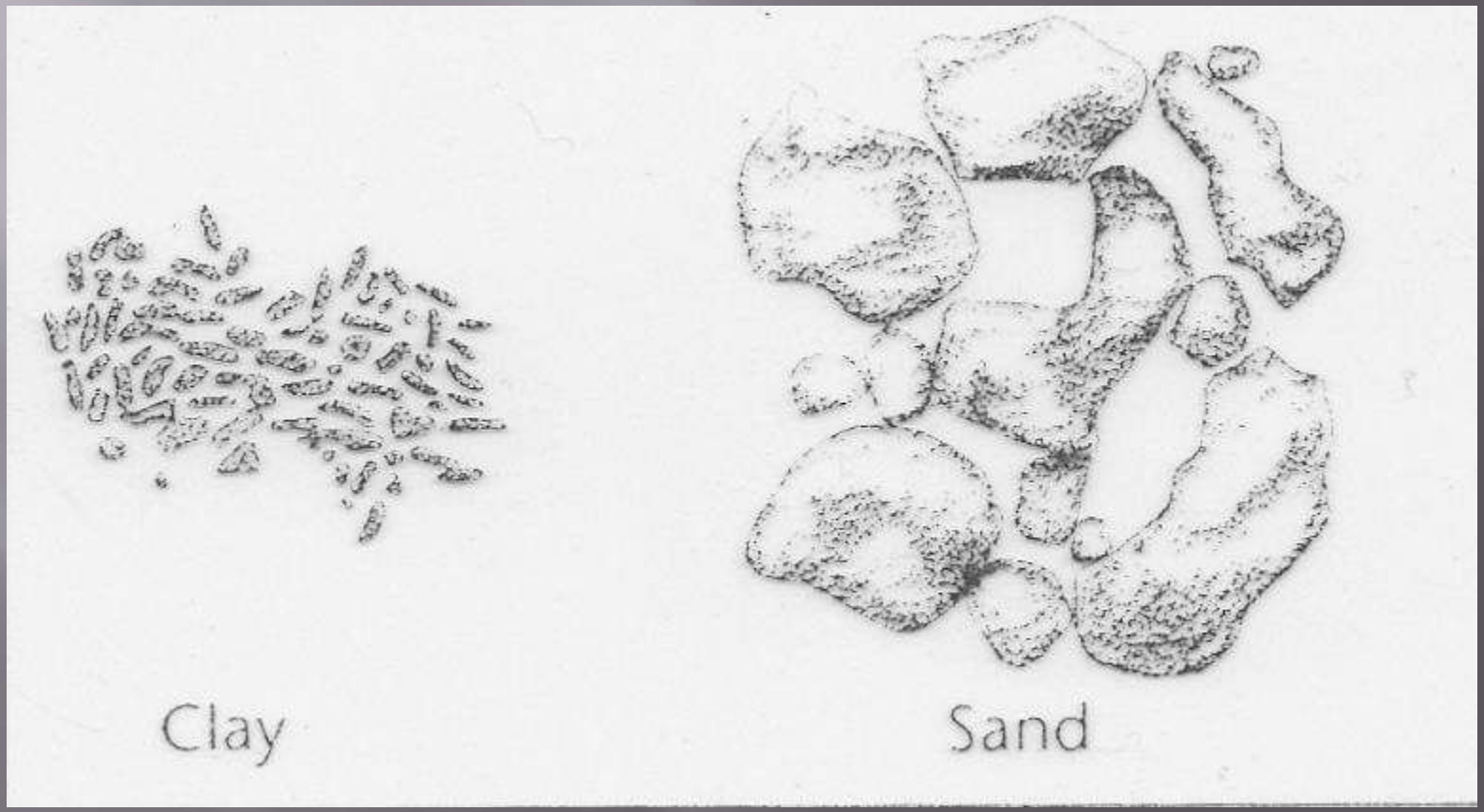
Fertilizer Recommendation Philosophy

There are three main methods used to make fertiliser recommendations:

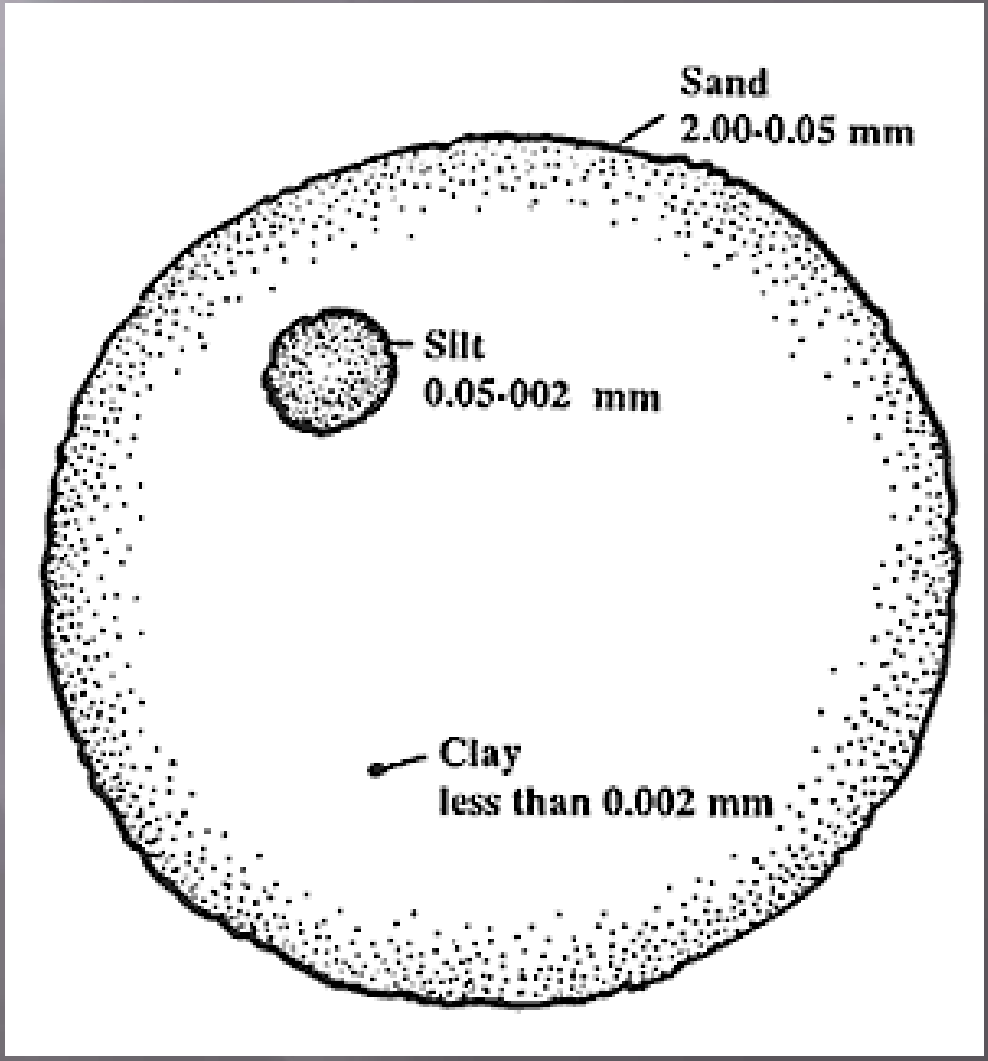
- **the sufficiency approach** -crop response to soil nutrient content has identified a soil test level at which crop response is no longer expected from nutrient addition.
- **build and maintenance approach** -applying nutrients in excess of crop removal as a means of increasing the soil test level to the non-responsive range.
- **the base cation saturation ratio** - the concept that maximum yield is only achieved by creating an ideal ratio of calcium (Ca), magnesium (Mg) and potassium (K).

Soil Texture

The coarseness or fineness of soil particles



Mineral Particle Size



What does texture tell us?

* **Fertility level - sandy soil will not hold nutrients or moisture**

  - clay soil will hold nutrients and moisture

* **Infiltration rate - water permeates to plant roots**

* **Cultivation aspects - sand easy to cultivate**

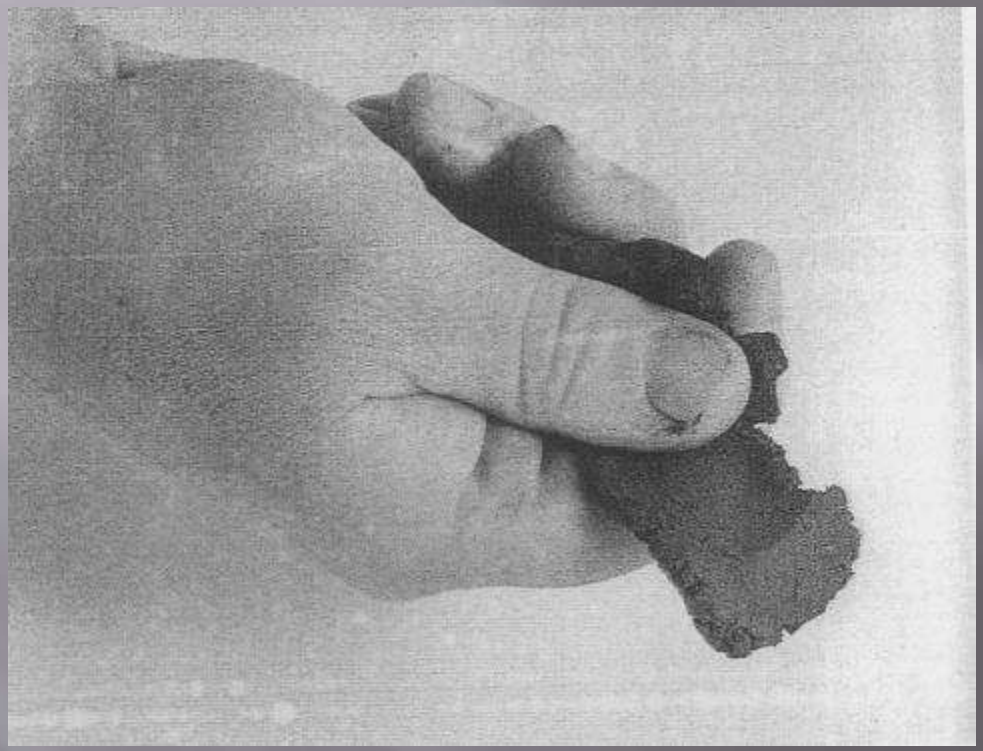
  - clay difficulty to cultivate

* **Cation exchange capacity - a guide to nutrient storage abilities of soil**

Soil Texture

- **Sandy soil** **<5% clay**
- **Sandy loam** **10-15% clay**
- **Loam** **20-25% clay**
- **Clay loam** **30-35% clay**
- **Clay soil** **35-40% clay**
- **Heavy clay** **>40% clay**

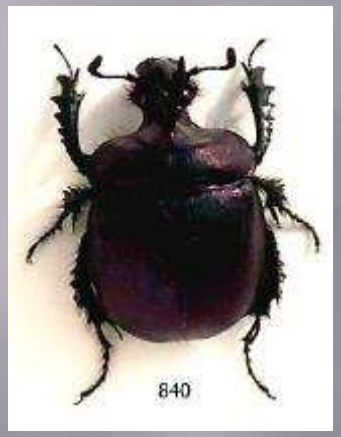
Activity-Soil Texture
Soil Ribboning



Enter Soil Texture on Work Sheet

Environmental Trivia

Which is the dung beetle?



A

B

C

D

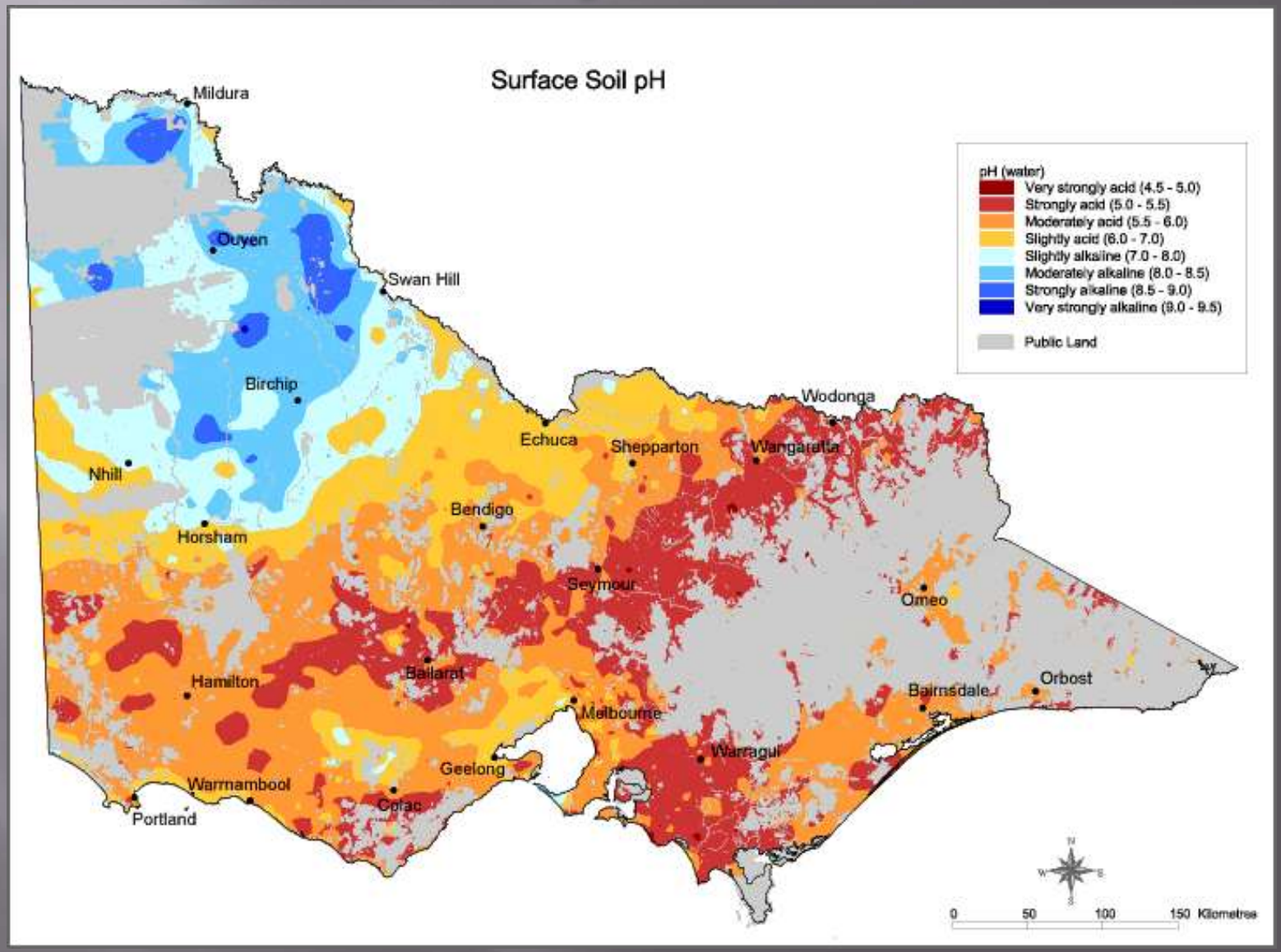
Soil pH

Soil acidity and alkalinity are described by the term pH.

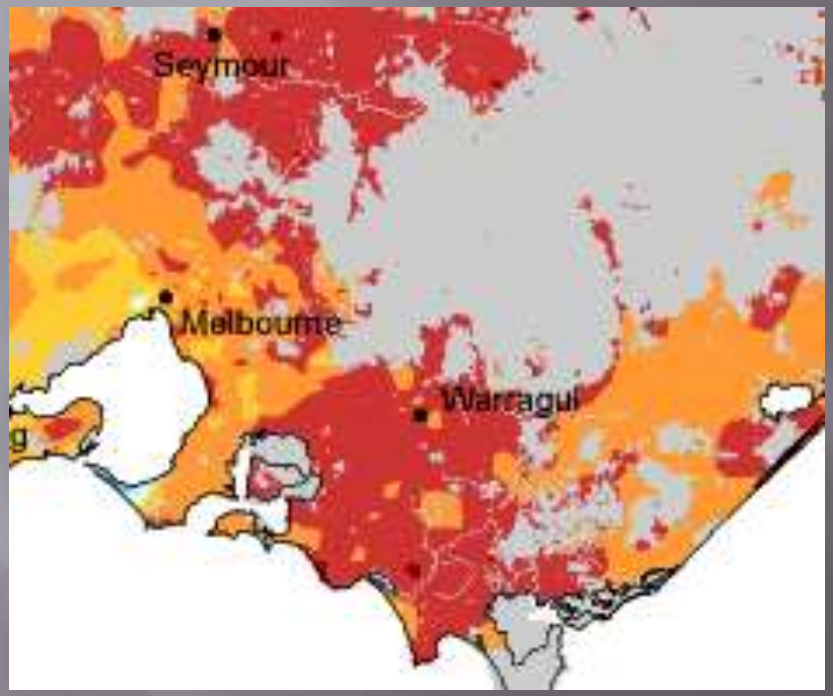
The degree of acidity or alkalinity expressed on a scale from 0 (mostly acid) -14 (mostly alkaline) 7 being neutral.

The scale is logarithmic, that means that each number moving down the pH scale is 10 times more acid than the one before it.

Soil Acidity in Victoria



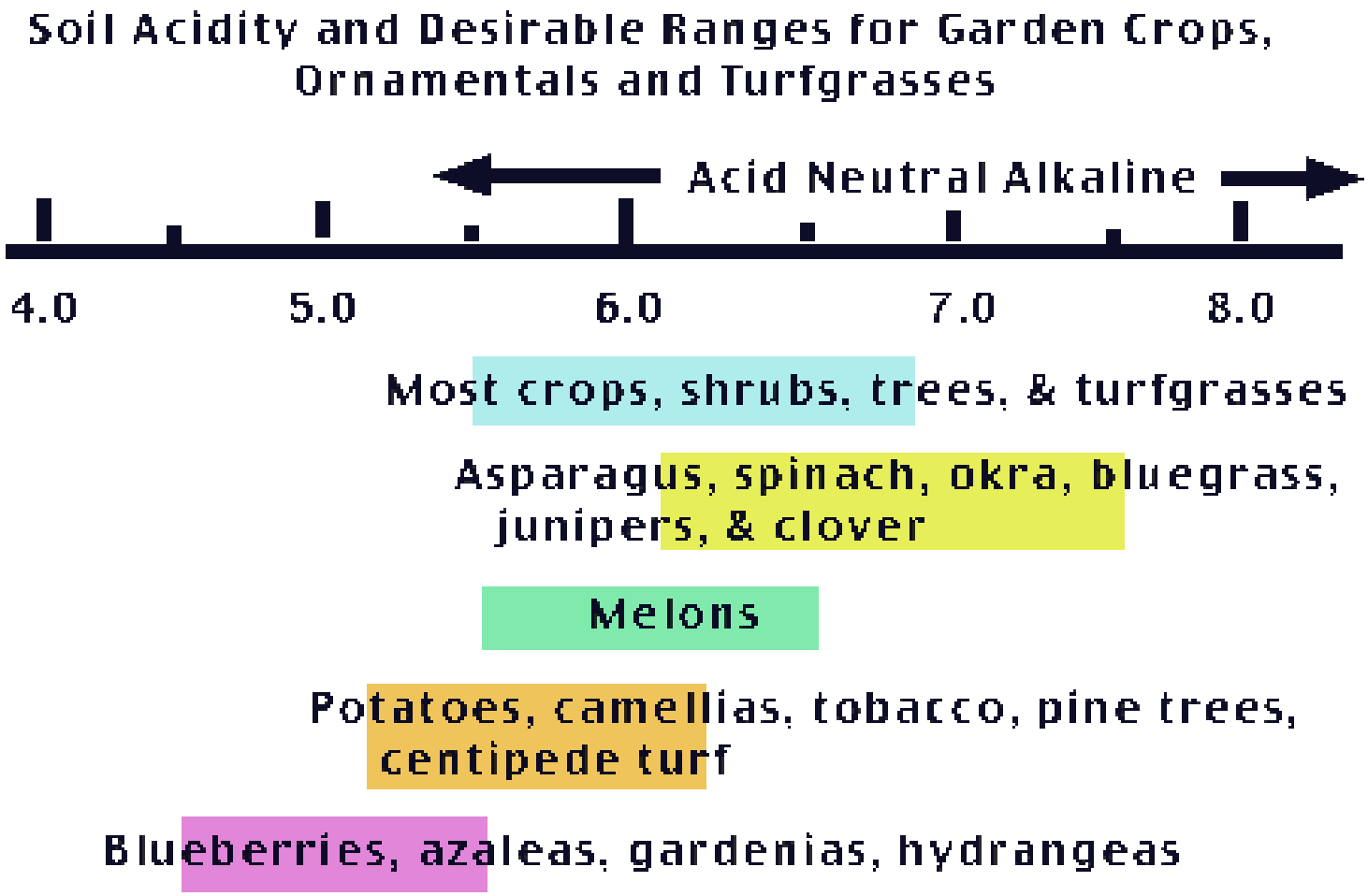
Soil Acidity in Victoria



pH (water)
- Very strongly acid (4.5 - 5.0)
- Strongly acid (5.0 - 5.5)
- Moderately acid (5.5 - 6.0)
- Slightly acid (6.0 - 7.0)
- Slightly alkaline (7.0 - 8.0)
- Moderately alkaline (8.0 - 8.5)
- Strongly alkaline (8.5 - 9.0)
- Very strongly alkaline (9.0 - 9.5)

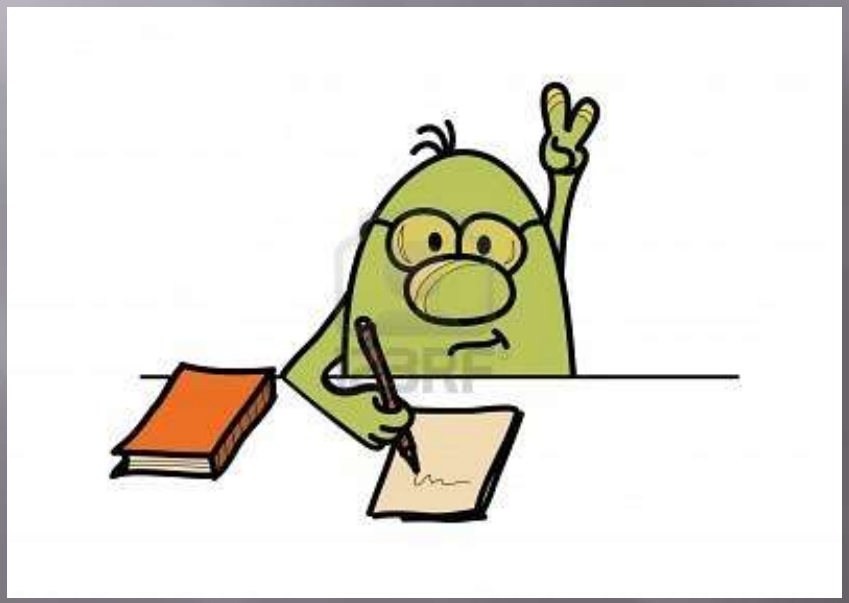
Public Land

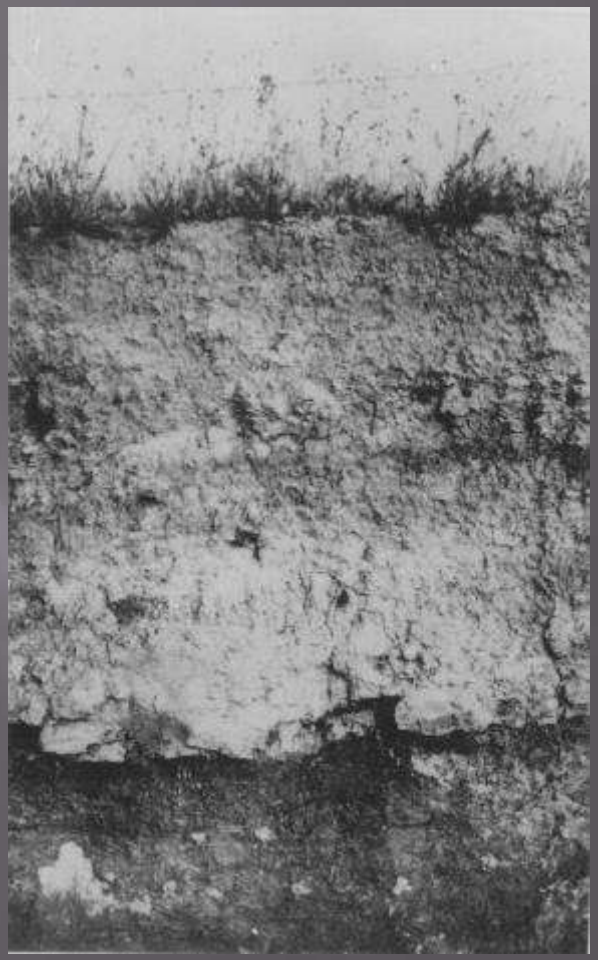
Plant pH Preference



Soil pH

How do soils become acid?





How Do Soils Become Acid?

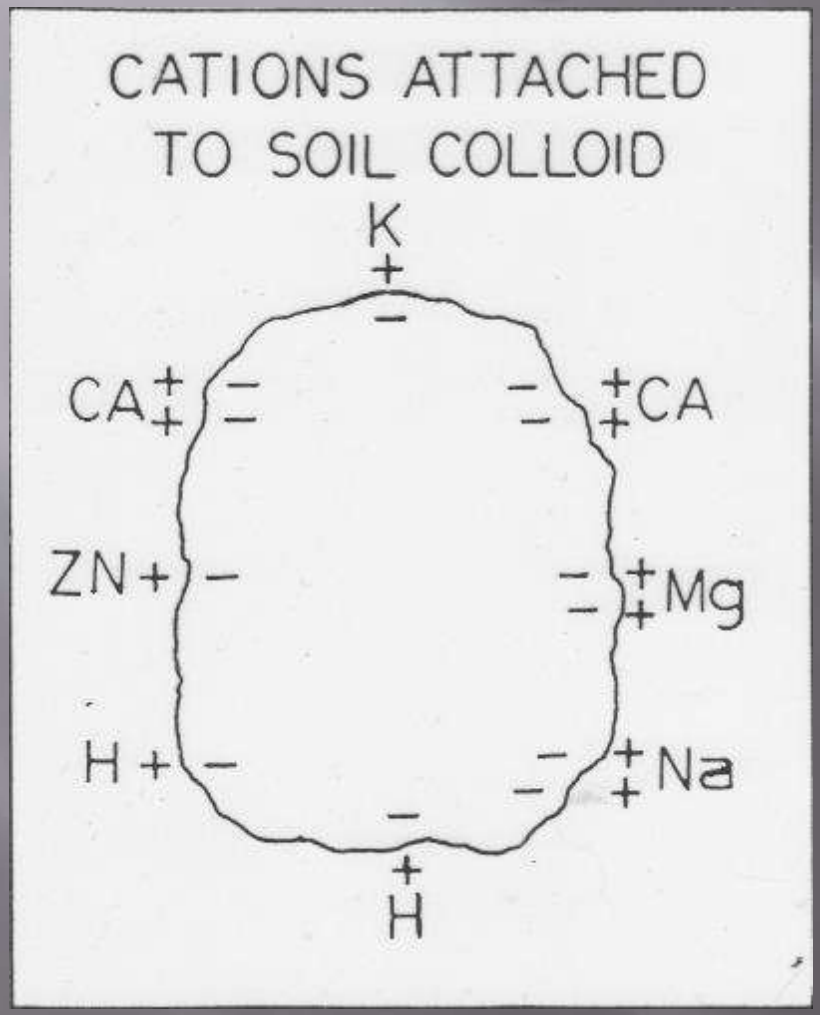
Major reasons for soils to become acidic are :

- Rainfall and leaching
- Acidic parent material
- Organic matter decay
- Use of legume based pasture
- Harvest of high-yielding crops
- Excess use of nitrogen fertilisers

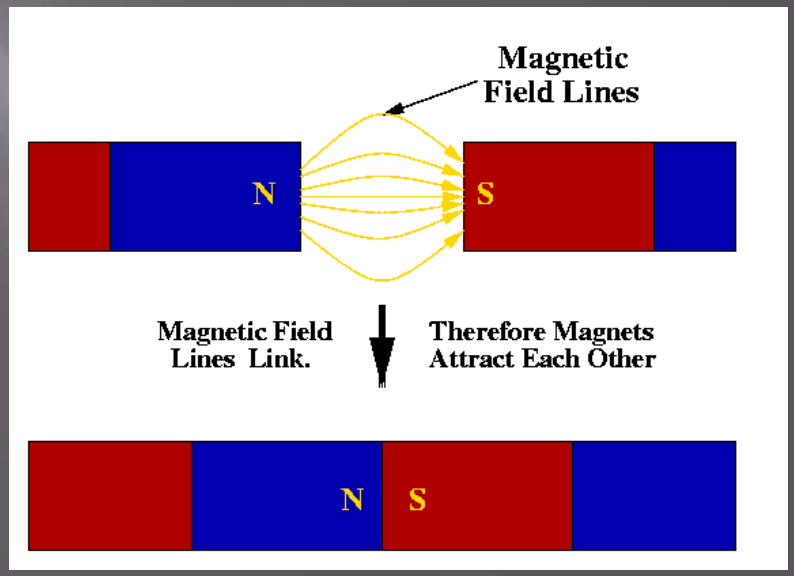
Cations and Anions

CATIONS (+) POS.	ANIONS (−) NEG.
Ca^{++} CALCIUM	NO_3^{-} NITRATE
Mg^{++} MAGNESIUM	$PO_4^{\equiv}$ ORTHO PHOS
K^{+} POTASSIUM	$SO_4^{=}$ SULPHATE
NH_4^{+} AMMONIUM	
H^{+} HYDROGEN	
Na^{+} SODIUM	
Cu^{++} COPPER	
ZN^{++} ZINC	
Mm^{++} MANGANESE	

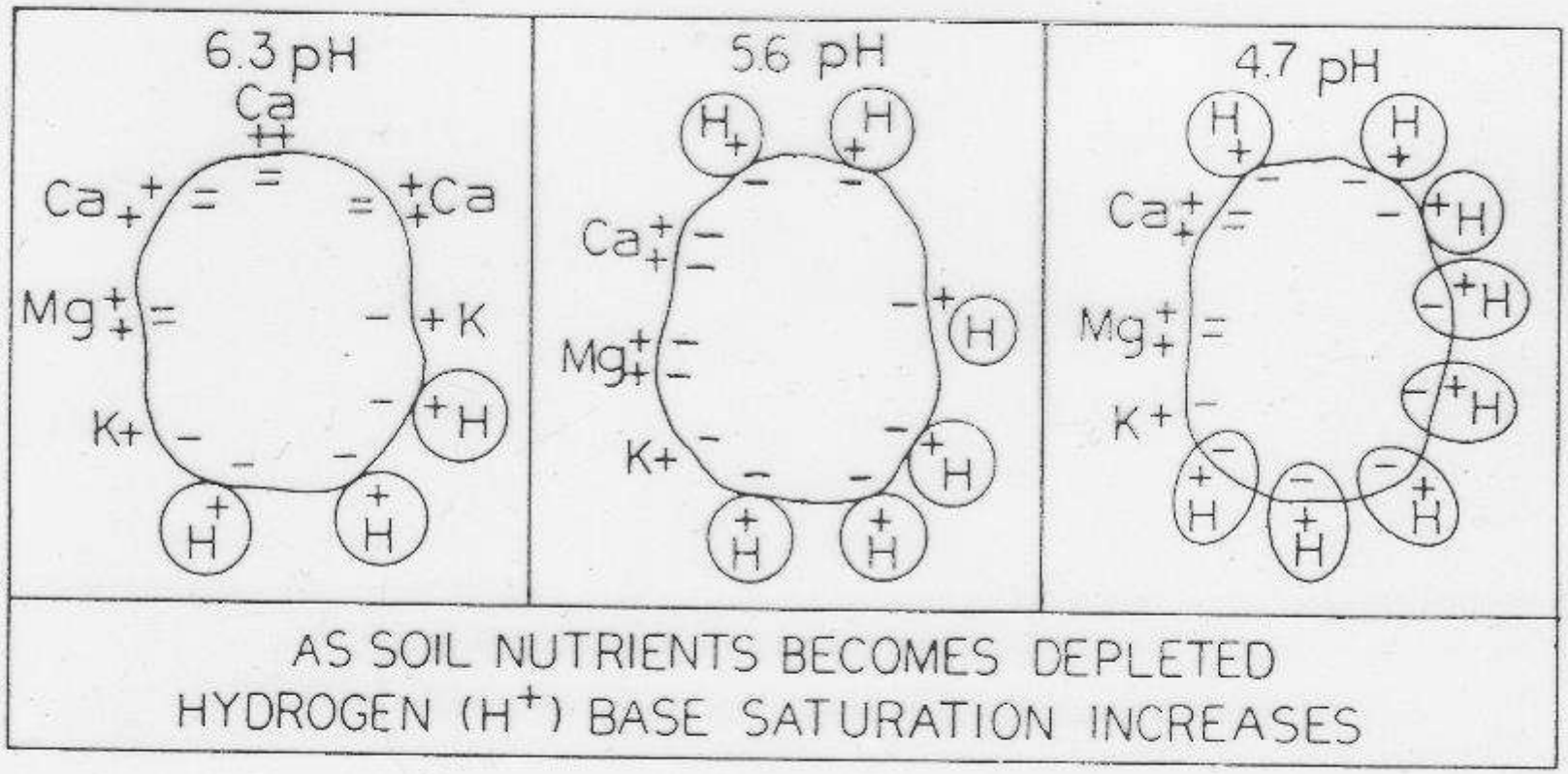
Positively Charged Cations Attracted to a Negatively Charged Soil Particle



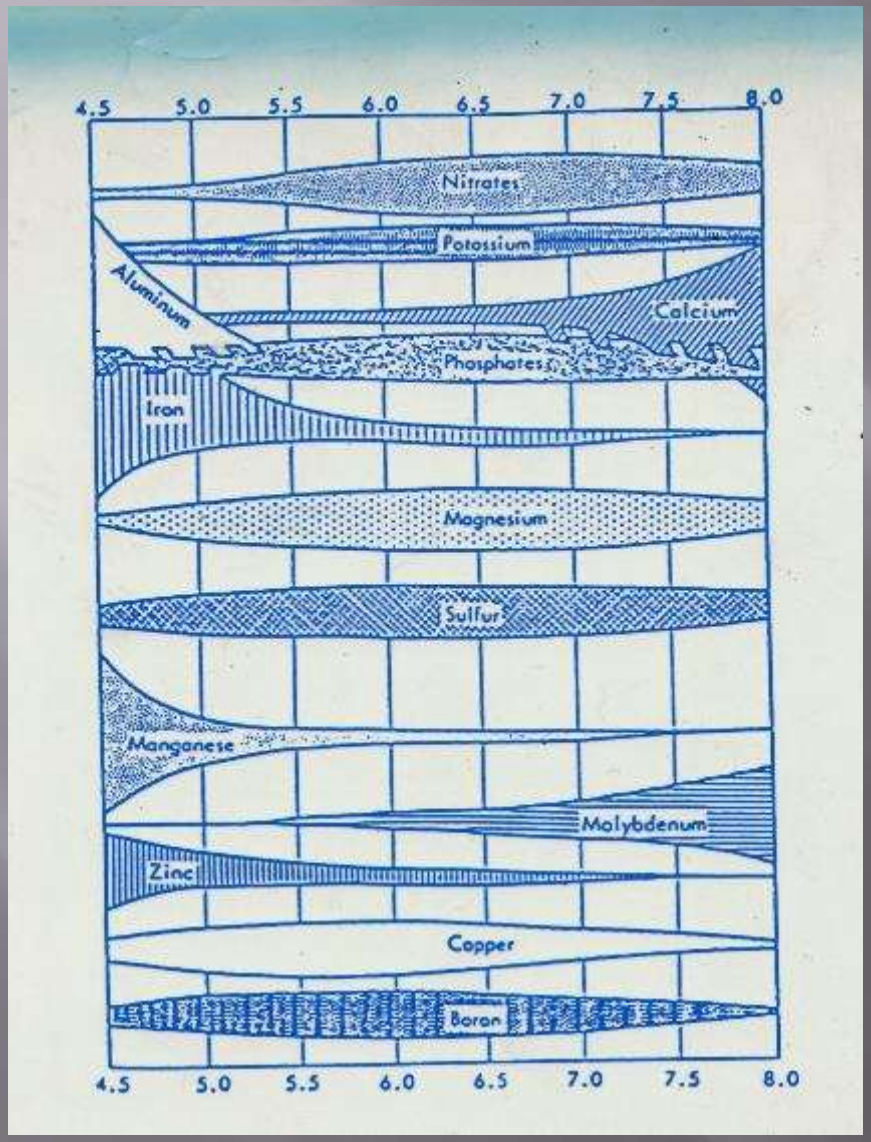
Soil Colloids are Clay & Humus

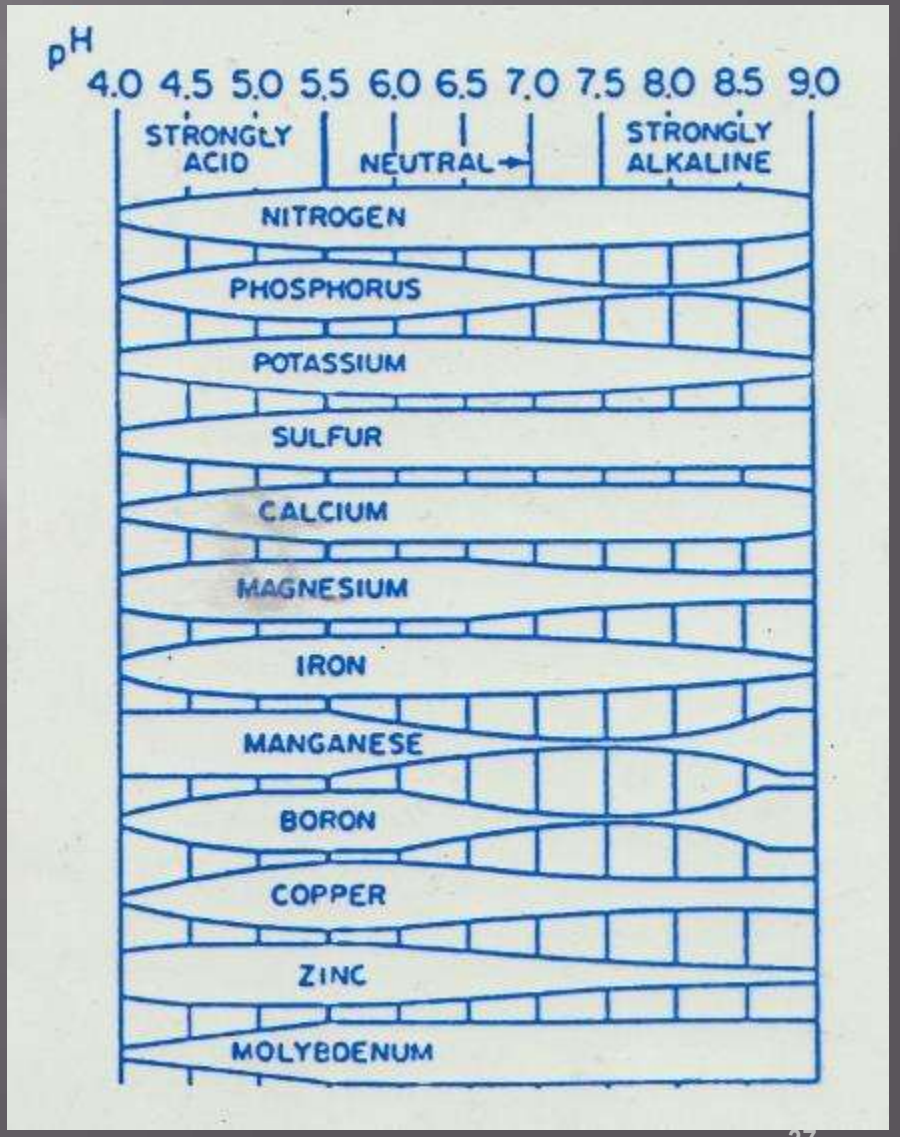


Effect of pH on Cations



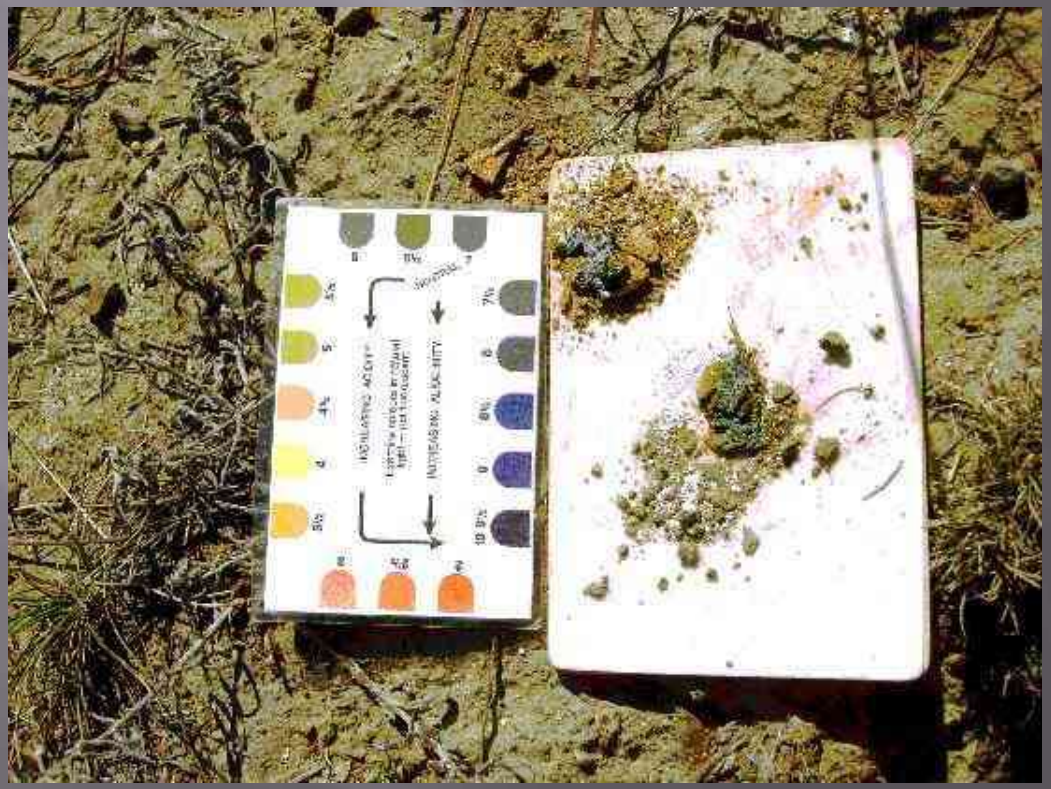
Soil pH and Element Availability





Let's Examine Our Soil pH

- What is the difference between pH measured in water and the pH in CaCl ?
- Which one should I use?



Soil pH

pH in CaCl

- The calcium chloride test is more useful for long-term monitoring of pH and is the one most agronomists tend to use for fertiliser and plant recommendations, it is expressed as **pH(1:5 CaCl)**

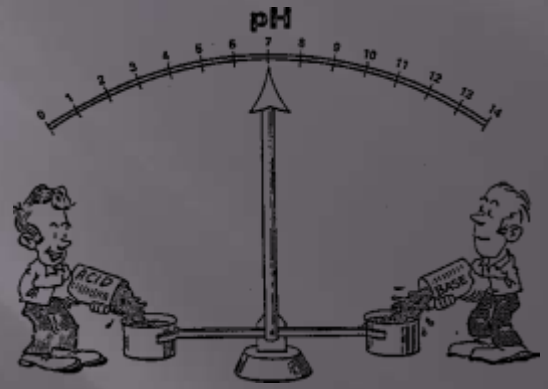
- When soil pH is measured in a solution of $CaCl_2$, the **pH is 0.5**  **-0.8** lower than if measured in water.

pH in Water

- The water method has been the test most commonly used in Victoria for over 30 years and more readily reflects current soil conditions than does the calcium chloride method it is expressed as **pH(1:5 Water)** **However**, the water method is more subject to seasonal variations and can vary as much as 0.6 unit.

Soil pH on Sample Analysis

- Enter the soil pH on your sheet for both water and CaCl – notice the difference
- Refer to the soil pH chart
- Enter on your sheets what elements may not be so available at this pH?
- If our pH dropped below 5.0, what elements would we have to keep an eye on for potentially undesirable levels?



pH and Phosphorus Availability

- **Enter on our work sheets the pH where phosphorus is likely to be tied-up (unavailable)**
- **Is this likely to be a problem with our two soils (check results on analysis sheets)?**

The optimum pH range of pasture plants

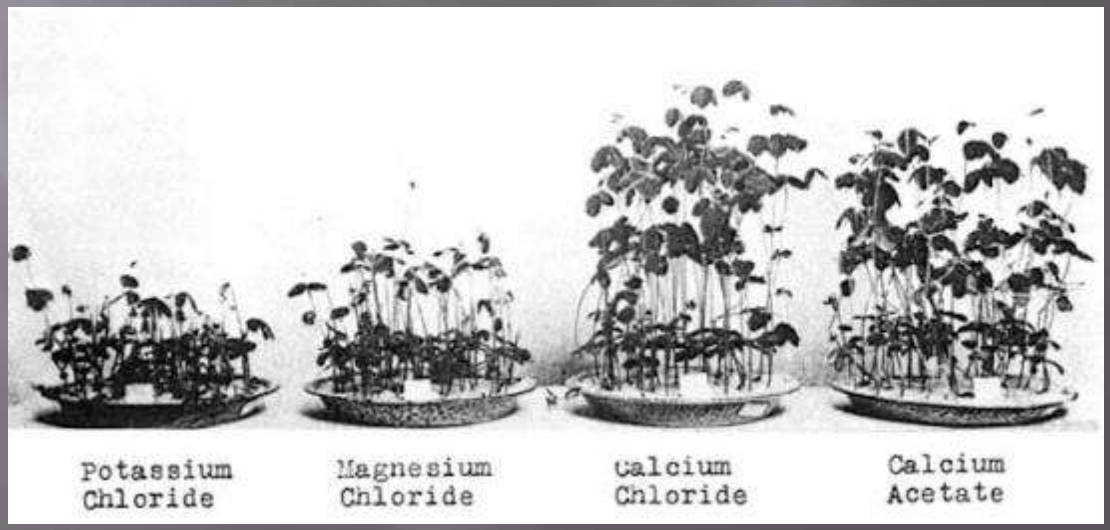
Pasture Species	pH ($CaCl_2$)	pH (water)
Sub clover	4.8 to 6.5	5.5 to 7.0
White clover	5.0 to 6.0	5.8 to 6.5
Perennial rye	4.3 to 6.0	5.0 to 6.5
Medic	5.3 to 8.0	6.0 to 8.5
Lucerne	5.2 to 7.5	5.8 to 8.0
Cocksfoot	4.3 to 6.8	5.0 to 7.5
Phalaris	5.2 to 7.3	6.0 to 8.0
Fescue	4.3 to 6.4	5.0 to 7.0

DPI, Victoria, *www.dpi.vic.gov.au/agriculture/dairy/pastures...dairy.../chapter-8*

Calcium Prince of Nutrients

Soil acidity maybe corrected by applying agricultural lime (Ca CO3) or dolomite (Ca,Mg CO3).

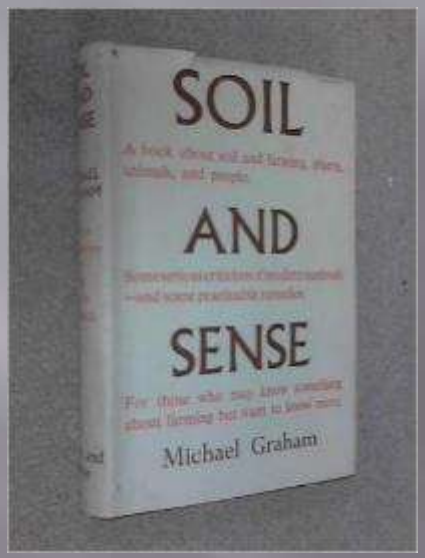
"Don't lime to fight soil acidity. Use lime to feed the plant". Wm Albrecht



Lime feeds the father starves the son

>400 year old saying

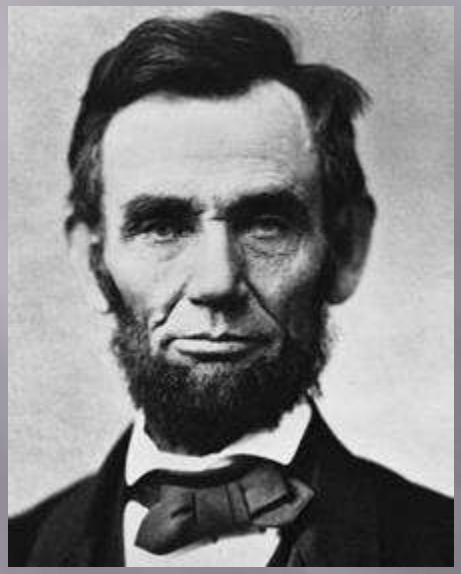
M. Graham, Soil and sense, 1941



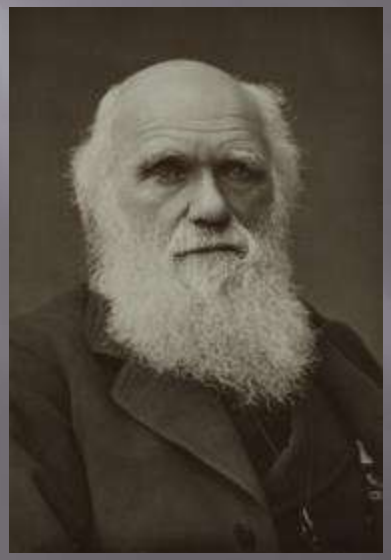
* sweeter soil
* less sticky
* better structure, crumbly, air
* neutralises acid
* worms
* better grasses

Environmental Trivia

Which one of these learned men researched & wrote on earthworms & what was his name?



A



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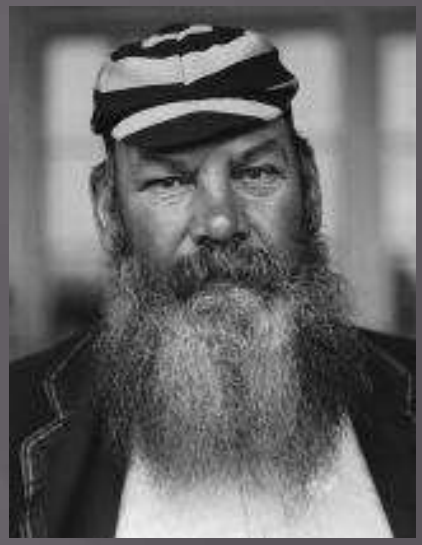


C

Bonus who are the other two men?

Let's Have a Break

Cation Exchange

CEC

5

⬇

20

The CEC of the soil is determined by the amount of clay and/or humus that is present, i.e. the soil colloids.

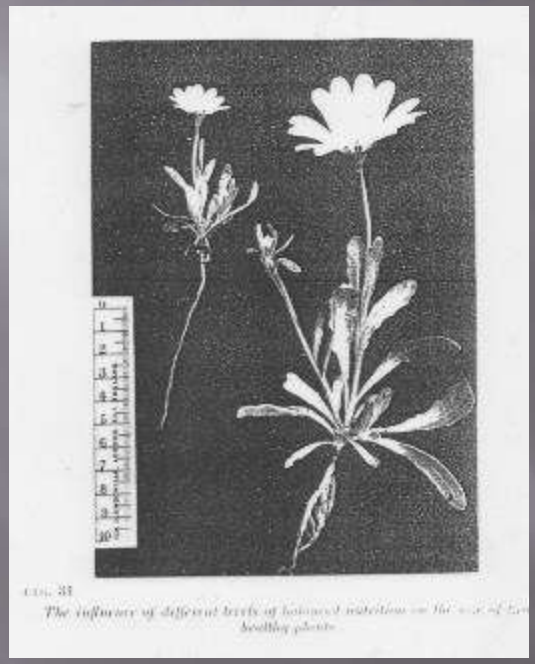
Soil Texture and Cation Exchange

Knowing our soil texture and allowing for organic matter/humus , estimate the cation exchange.

	CEC (me/100g)
Sands	1 – 5
Sandy loams	5 – 10
Clay loams	15 -30
Clays	over 30
Humus	~100- 300

Enter the Effective and Adjusted Cation Exchange from your two soil reports. How close did we get?

Effect of Cation Exchange on Plant Growth



A CEC greater than 10 meq/100g is desirable (usually heavy loams or clay loams with good organic matter).

Less than 10 meq/100g usually indicates a sandy soil low in organic matter , which may be prone to leaching.

Cation Balancing Based on Wm Albrecht's Research

SUGGESTED C.E.C. SATURATION

CALCIUM
65 TO 70%

MAGNESIUM 14 – 16%

HYDROGEN
10 – 11% = 6.3 Ph.

POTASSIUM 3 – 7% | SODIUM TRACE

William A. Albrecht

Cation Balancing Based on Wm Albrecht's Research

Our Soil	Ideal *
Ca ----------	65-70%
Mg ---------	14-16%
K ----------	3-7%
Na ----------	1.7%
H ----------	10-11%

* Based on the work of Wm Albrecht

From the two analyses enter the CEC of these elements on our work sheets

Exchangeable Cations

Our Soil	**Ideal ***
Ca ---------	65-70%
Mg --------	14-16%
K ---------	3-7%
Na ---------	1.7%
H ----------	10-11%

* Based on the work of Wm Albrecht

- Which cations are the most deficient in the Southern Cross and SWEP analysis?

The Exchangeable Cations

	Ideal
Calcium	65-70%
Magnesium	14-16%
Potassium	3-7%
Sodium	1.7%
Hydrogen	10-11%

An exchangeable magnesium %age > 20 could induce **potassium** deficiency. Conversely if exchangeable potassium is > 10 **magnesium** deficiency may occur. A ratio of 2:1 Ca to Mg indicates a well structured soil.

Environmental Quiz

The following exhibit trace element deficiencies. Which is the potassium deficiency?

A

B

C

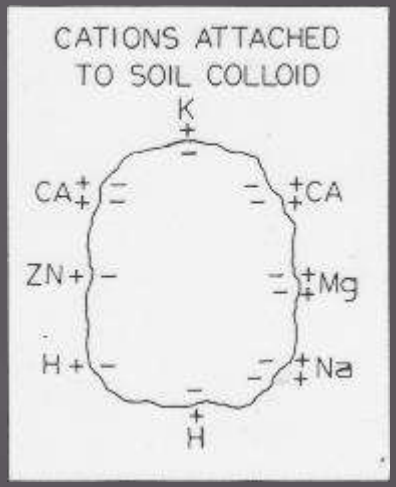
Measurement of Salinity

- Soil salinity can be measured by determining the electrical conductivity of a solution, obtained by saturating a soil sample with water (a soil 'saturation extract', 1:5 soil/water).
- The greater the salt content the greater the current. Most conductivity meters give readings in **micro Siemens per cm (µS/cm).**

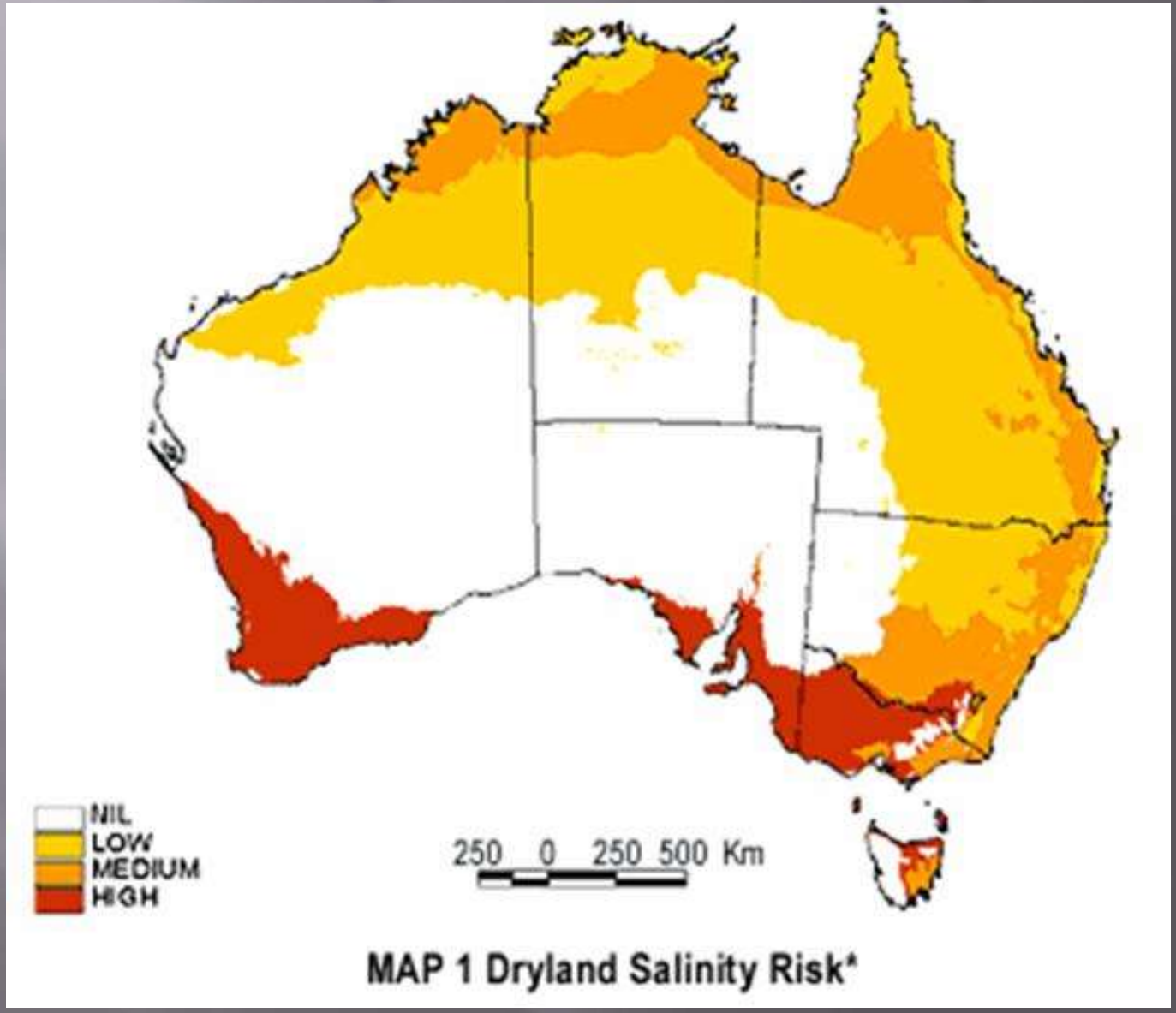
Saline and Sodic Soils

- **Saline soils** - Sodium and chlorine are the major issues, together they form a salt

- **Sodic soils** - the chlorine has been washed away leaving the sodium attached to clay particles resulting in unstable soils which don't stick together. Easily erodible by wind and water

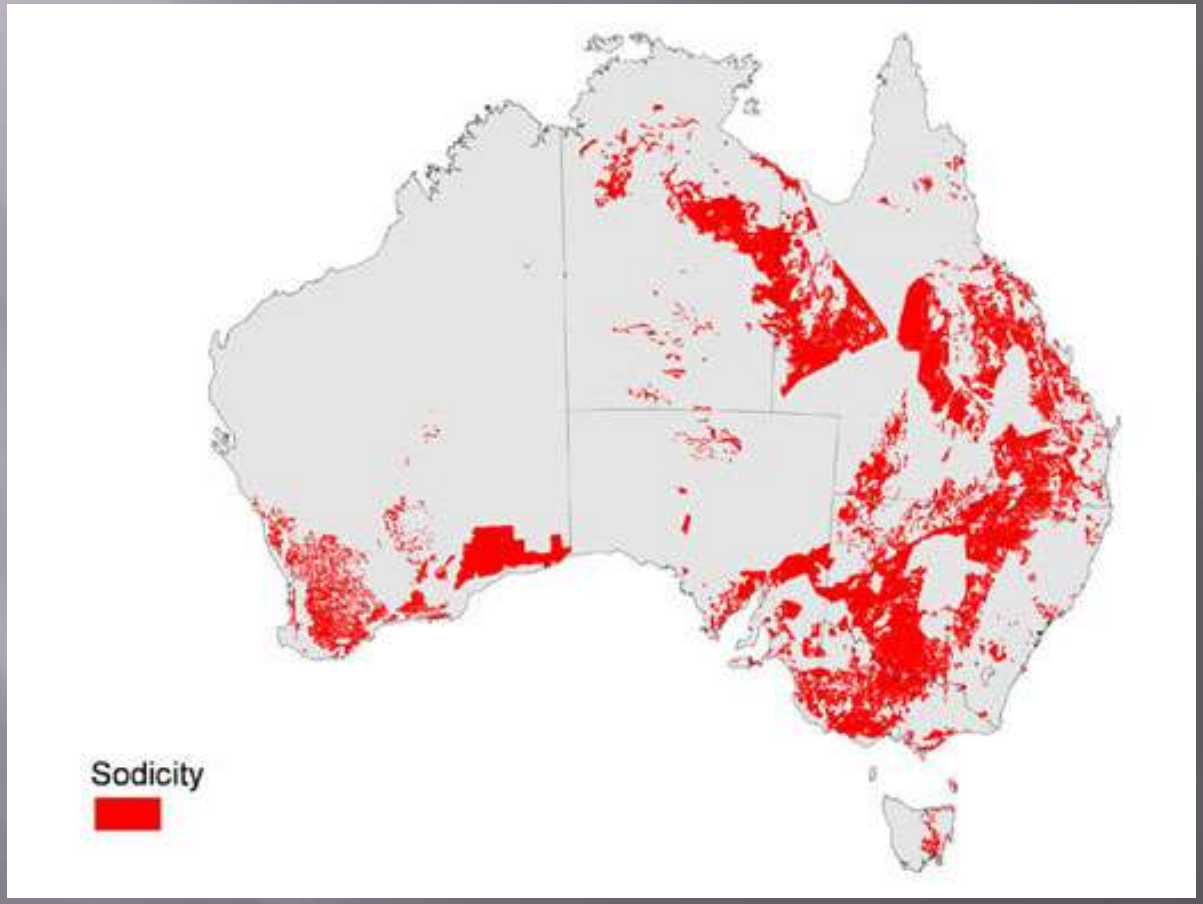


Dryland Salinity



MAP 1 Dryland Salinity Risk*

Sodic Soils In Australia



The map shows areas where soil sodicity reduces the potential productivity

Measurement of Salinity
Examine our Soil analysis

Items		Results	Desirable Level
Electrical conductivity	EC dS/m (S.Cross)	0.179	<.20
Total soluble salt TSS	ppm (SWEP)	178.2	<990

Note:

(1) Sometimes conductivity is reported in deci Siemens per meter (dS/m) The conversion is 1 dS/m = 1000 µS/cm.

(2) Total Soluble salt (TSS) is a measure of dissolved solids and its usually on a weight for volume basis so 178 ppm in water means there are 178 mg of solids per litre

Measurement of Salinity

- From the Sthn Cross analysis enter the soil EC on your sheet, but first convert the test results (0.179 dS/m) to µS/cm (1 dS/m = 1000 µS/cm.)
- From the SWEP analysis enter the total soluble salt TSS on your sheet
- Are these measurements within desirable limits?

Measurement of Salinity

- 0-800 µS/cm - good drinking water
  -Generally good for irrigation
  -suitable for livestock
- 800-2500 µS/cm- can be consumed by humans
  -special care required when used for irrigation
  -suitable for all livestock
- 2500-10,000 µS/cm - not recommended for human consumption
  - not normally used for irrigation
  - most livestock can tolerate levels up to 10,000 µS/cm
- Over 10,000 µS/cm - not suitable for human consumption or irrigation
  - beef cattle can consume up to 17,000 µS/cm

Exchangeable Sodium Percentage (ESP)

In Australia, soil with an ESP greater than 6 % is considered to be sodic.

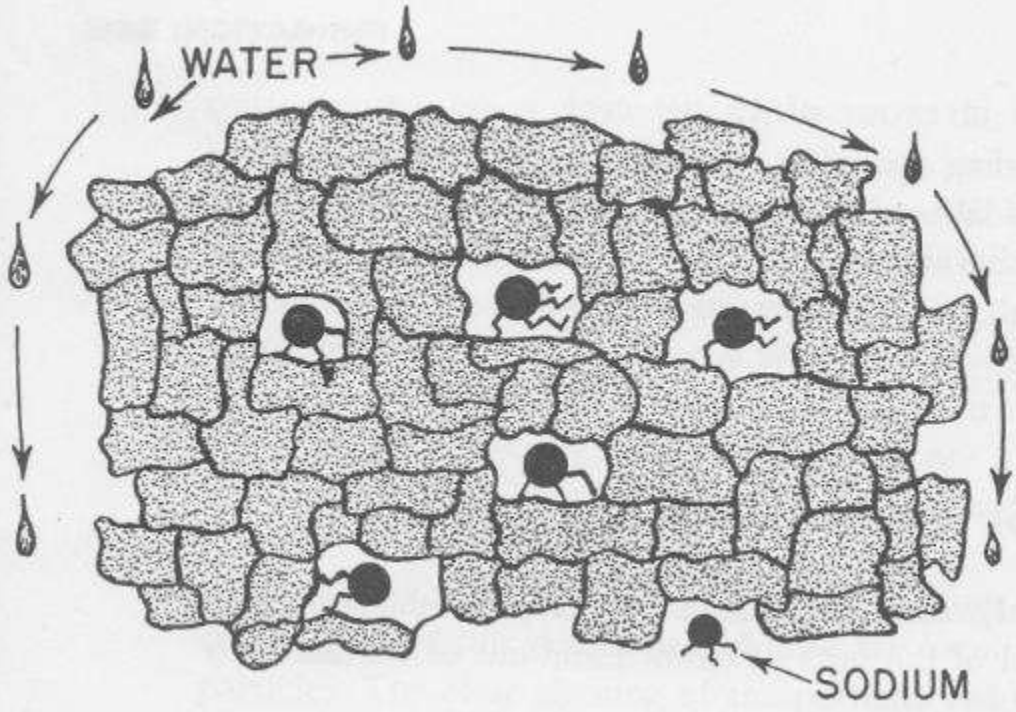
Exchangeable Sodium	Classification Percentage	Non-sodic <6	Sodic 6-10	ModeratelySodic 10-15	Strongly Sodic 15-25	Very strongly Sodic 25

From the Sthn Cross analysis enter the Exchangeable Sodium Percentage (ESP) on your worksheets

Is that within limits?

Reclaimation of Sodic Soils

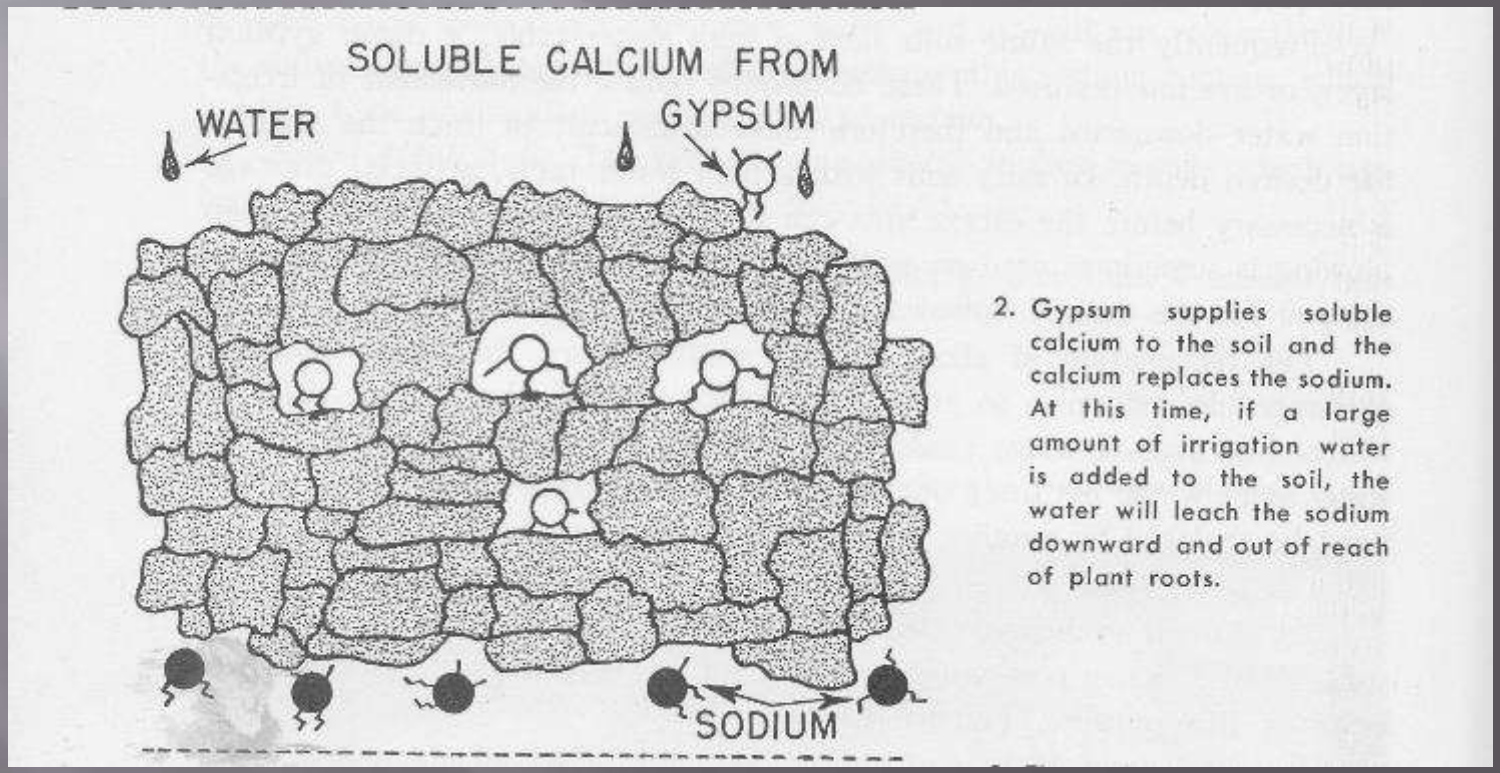
- Large amount of sodium in the soil and it becomes very compact and hard. Water does not permeate and plants struggle.



1. When there is a large amount of sodium in the soil, the soil becomes hard and compact like a brick. The compacted soil will not permit water to pass downward readily, and, as a result, plant growth is retarded.

Reclaimation of Sodic Soils

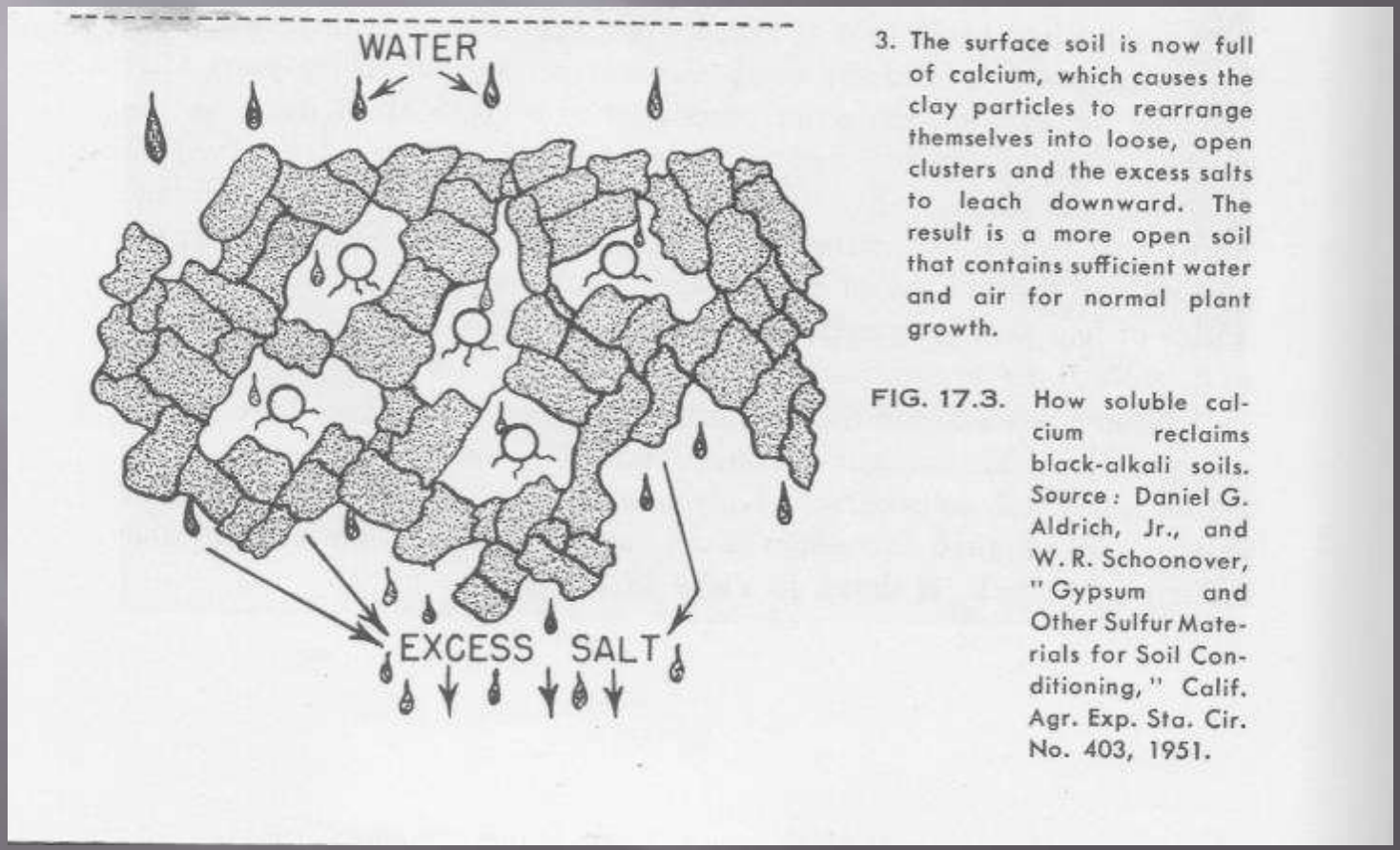
- The sodium in a sodic soil must be replaced with another cation – generally calcium through the addition of gypsum (Ca SO4)



2. Gypsum supplies soluble calcium to the soil and the calcium replaces the sodium. At this time, if a large amount of irrigation water is added to the soil, the water will leach the sodium downward and out of reach of plant roots.

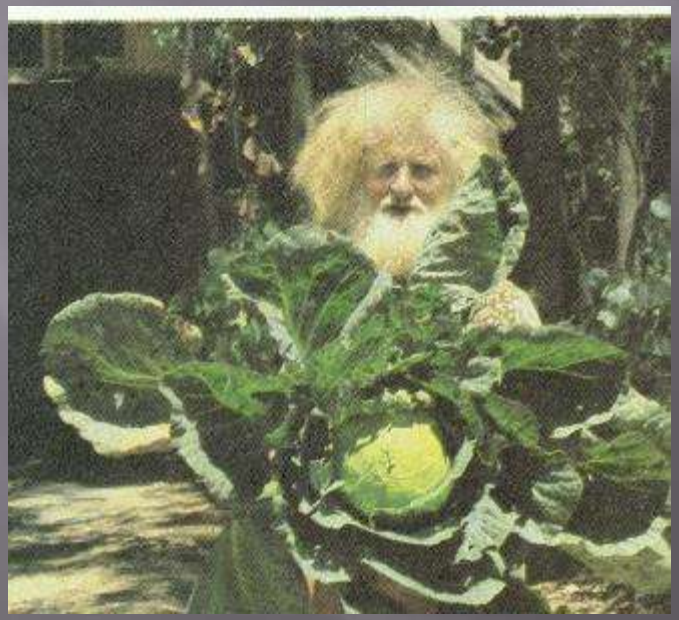
Reclaimation of Sodic Soils

- Surface soil now full of calcium and clay particles rearrange themselves into loose, open clusters & excess salt leaches downwards.



Environmental Quiz
Who is Neil Douglas?

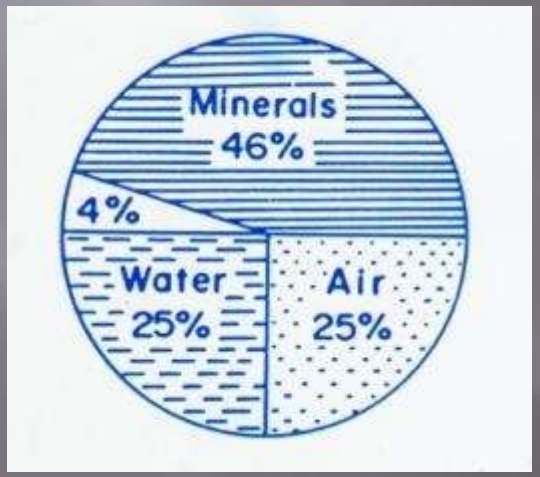
A. He was a conservationist/artist whose paintings hang in the National Gallery
B. He was a member of John Brumby's cabinet
C. He was a CEO of Green peace in the 1980's
D. He wrote the classic work, " Make peace with the earth".

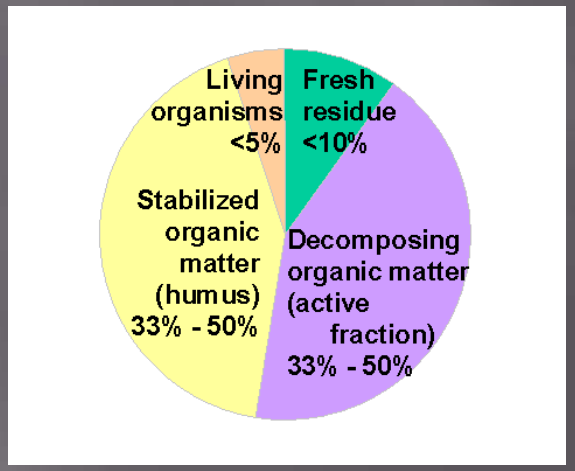


Neil Douglas

Organic Matter

Soil organic matter comprises all the living, dead and decomposing plants, animals and microbes in the soil along wit the organic residues and humic substances they release.





Australian Soil's Organic Carbon

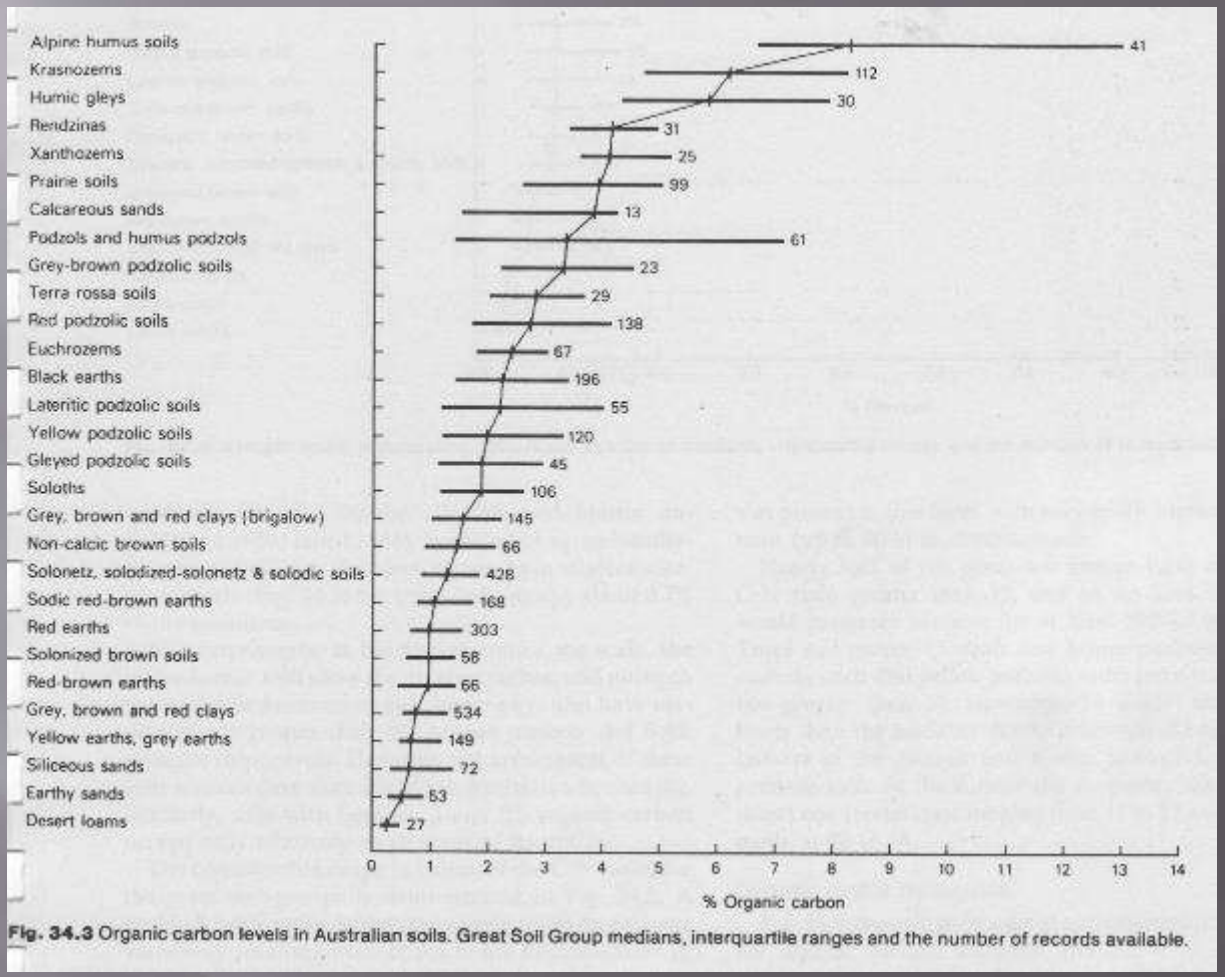


Fig. 34.3 Organic carbon levels in Australian soils. Great Soil Group medians, interquartile ranges and the number of records available.

'More than 75 percent of Australian farming soils have organic carbon contents less than 1.75 percent,'

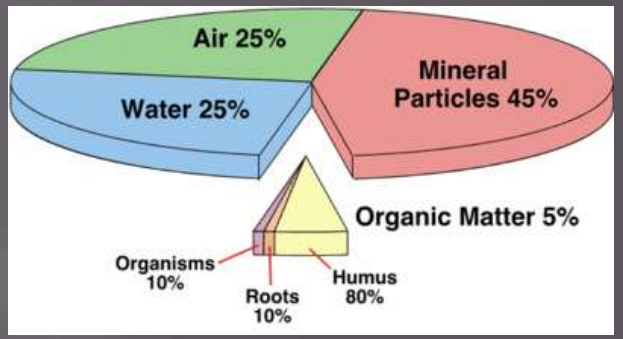
Dr Brian Tunstall of the Environmental Research and Information Consortium, formerly with CSIRO

The Benefits of Humus

Storehouse of essential nutrients, 95% N, 60%P, 70%S

The Benefits of Humus

- Makes minerals more soluble & available to plants
- Contains substances that stimulate plant growth
- Provides substances that bind soil particles together
- Provides high water absorption & nutrient holding capacity
- Contributes to good soil structure-tilth
- Buffers soil against high salt levels & toxic chemicals
- Provides food for beneficial soil organisms

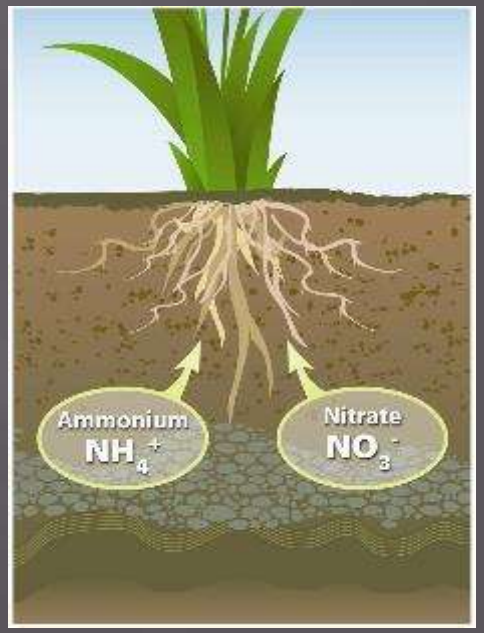


Organic Matter & Organic Carbon

- To determine the amount of organic matter organic carbon is analysed and then multiplied by a factor of **1.6 to 1.74**
- On high rainfall pastures (Greater than 400mm per year) levels of organic matter would be expected to be between 5-10%.
- **From the Sthn Cross analysis enter on your sheets the organic matter and the organic carbon.**

Total Nitrogen

- Total nitrogen is an indication of what reserves may be held in the soil and with good management some of this might be available for our crops. It should not be used as a guide for fertiliser additions.



Enter on your sheets the total nitrogen from the Southern Cross and SWEP analysis.

Nitrogen Levels in Australian Soils

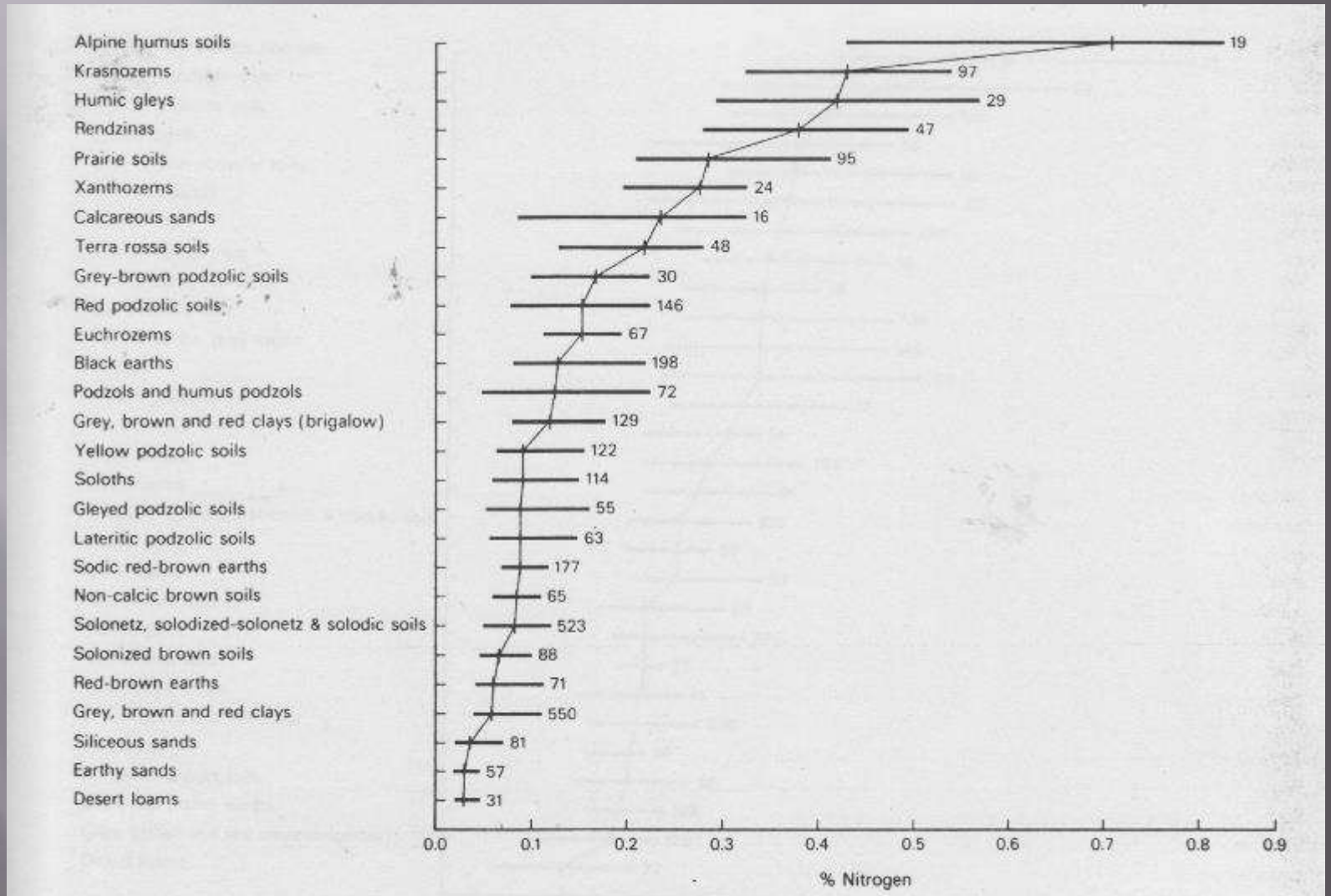
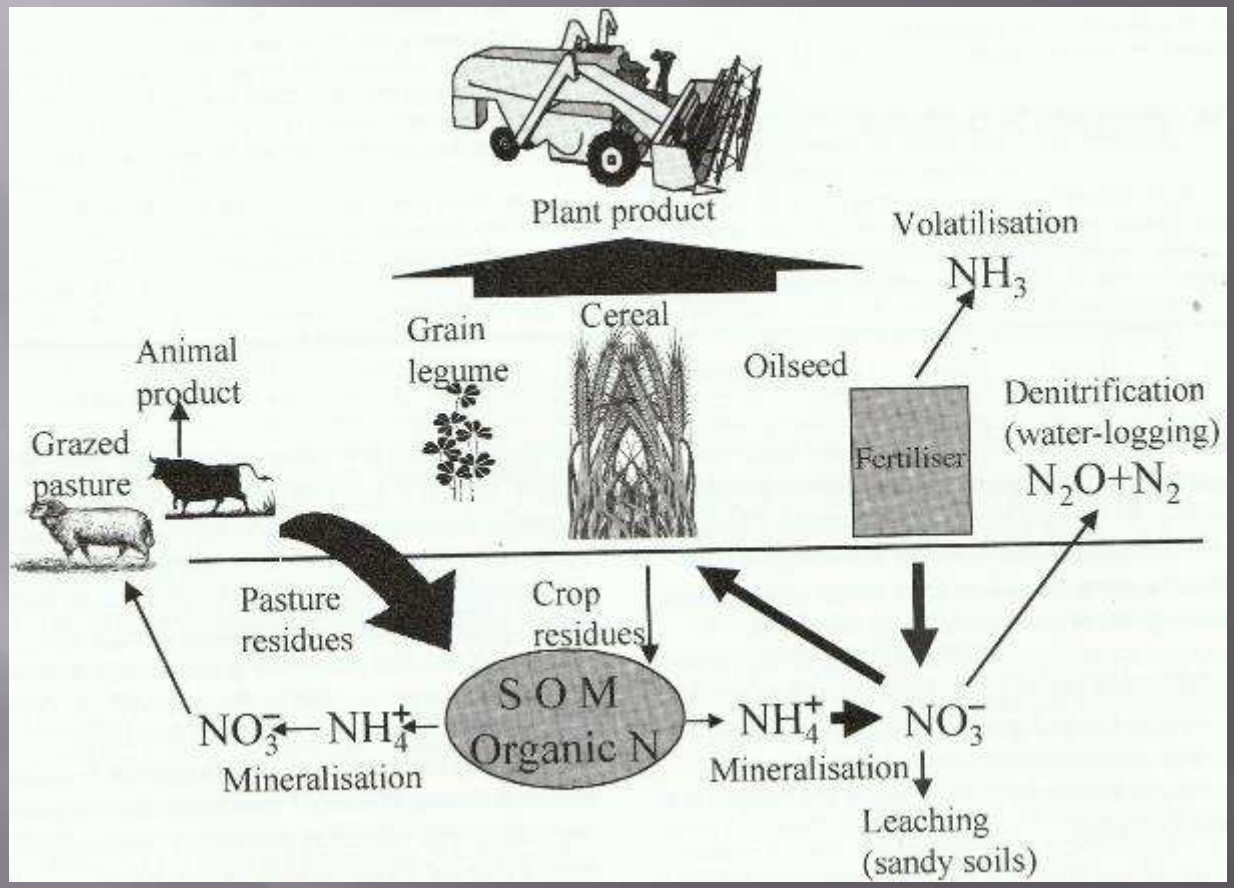


Fig. 34.4 Nitrogen levels in Australian soils. Great Soil Group medians, interquartile ranges and the number of records available

Available Nitrogen

- **Interpretation of soil tests for nitrate nitrogen are highly controversial as levels fluctuate widely, depending on the season or rainfall.**
- **Levels between 10-20ppm for nitrate are generally suggested as good levels.**
- **Ammonium N (NH_4-N) is just as available to plants as is nitrate N (NO_3-N), but generally little accumulates in the soil because it is readily converted to nitrate under most conditions.**

The Nitrogen Cycle



- Principle pathways of nitrogen cycling in cropping systems involving ley pastures CSIRO, Pevrill, 1999

Nitrogen

- About 10-20kg N per ha will be released (mineralized to nitrate) annually from each 1 percent O.M. present.

- What is the organic matter on your Southern Cross soil test?
- Enter on your sheets the N per ha that might be mineralised from the organic matter.

Nitrate Nitrogen

Enter on your work sheets the available nitrogen (nitrate) from the Southern Cross and SWEP analyses.

	Sthrn Cross	SWEP
Organic matter	13.1	7.5
Nitrate N	10.7 (15)	3.3 (21)

Remember organic mater contains up to 95% of soil nitrogen

Environmental Trivia

Discolouration around the eyes, fading of coat colour, sparse dry hair in cattle are signs of which trace element deficiency?

(i) Selenium

(ii) Calcium

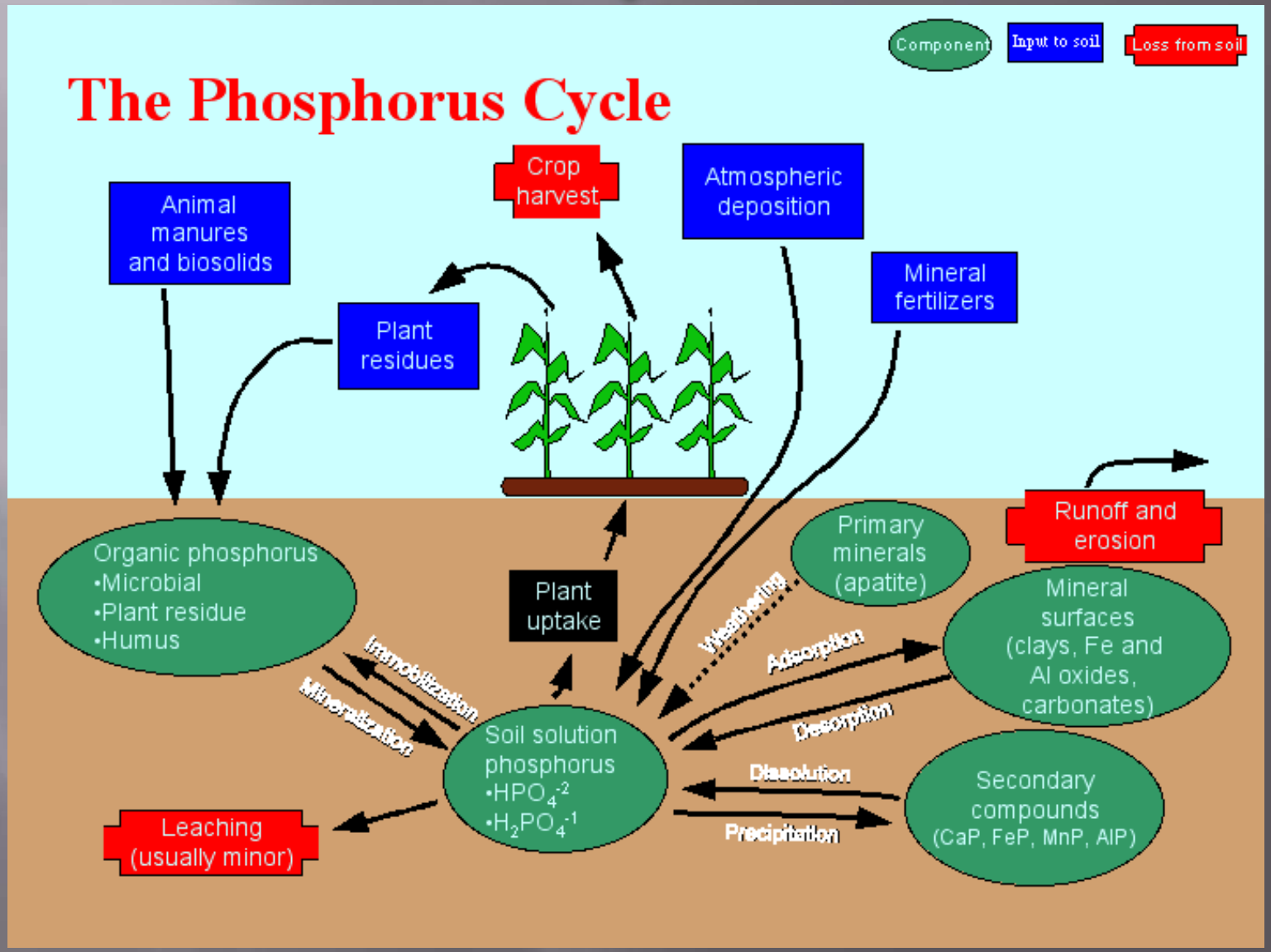
(iii) Copper

(iv) Magnesium

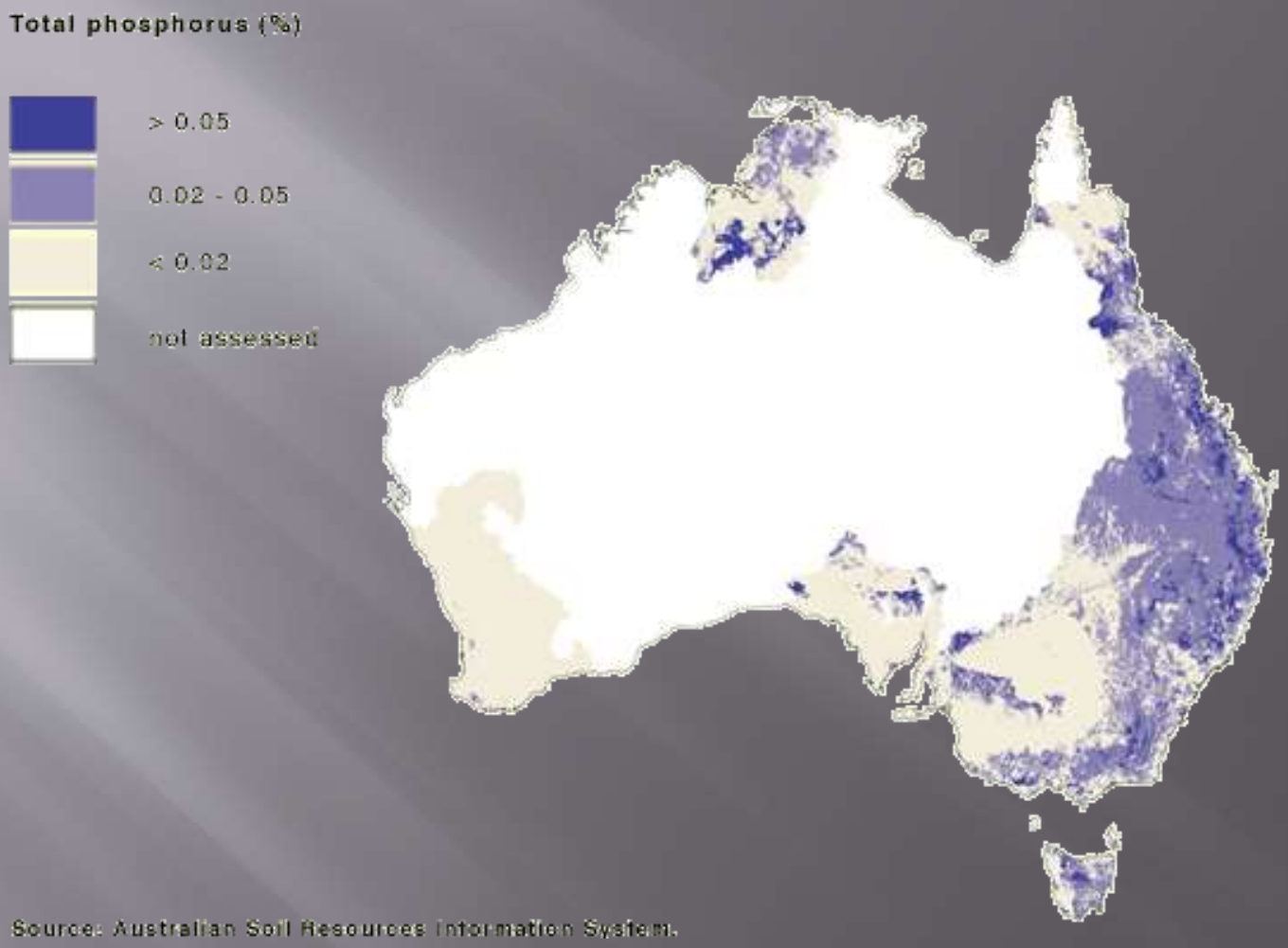
Phosphorus

- The difficulty in analysing for soluble phosphorus lies in the fact that its composition is so variable.
- Soil P exists in several chemical forms in the soil. This includes both inorganic complexes (with calcium, iron, aluminium) and organic forms.
- "In perennial pastures, organic matter tends to accrue and net mineralisation of P from the microbial biomass and organic residue pools may be a significant source of P ". Pevrill,1999

Phosphorus


Component
Input to soil
Loss from soil
The Phosphorus Cycle
Crop harvest
Atmospheric deposition
Animal manures and biosolids
Mineral fertilizers
Plant residues
Runoff and erosion
Primary minerals (apatite)
Organic phosphorus
•Microbial
•Plant residue
•Humus
Plant uptake
Weathering
Adsorption
Mineral surfaces (clays, Fe and Al oxides, carbonates)
Immobilization
Mineralization
Desorption
Soil solution phosphorus
•HPO_4^{-2}
•$H_2PO_4^{-1}$
Dissolution
Precipitation
Secondary compounds (CaP, FeP, MnP, AlP)
Leaching (usually minor)

Distribution of Total P in Australian Topsoils



Most Australian soils contain less than 0.02%(200ppm) phosphorus

Phosphorus Methodologies

- Colwell- employs a Na HCO3 extractant ratio of. 1:100 & a 16 hour shake. Primarily estimates quantity.

  Usually extracts a larger amount of P than the Olsen method.

  Field calibration of these tests in Victorian conditions is rare.

- Olsen –employs a Na HCO3 extractant ratio 1:20 for 30 minutes. Gives composite estimates of availability. Errors of up to 30% are not uncommon

- Bray 1 & 2 give composite estimates of P availability

  Bray 1 dilute HCl extractant , Bray 2 stronger acid concentration

- Morgan- universal extractant. The Morgan Extraction and modified Morgan (Reams Test) is supposed to closely measure plant available P. The test appears to have no merit over existing tests.

Note: Other available phosphorus tests (for example, Colwell or Bray) are used by various laboratories, but field calibration of these tests in Victorian conditions is rare.

Phosphorus

The Olsen P test is a measure of **plant-available P**. The test has been extensively calibrated against pasture production (including the Phosphorus for Dairy Farms Project and other trials) over a range of soils and climates in Australia and New Zealand.

- **Examine the SWEP and Sthrn Cross (Colwell) analysis and enter the available P on your work sheet.**
- **Is the level at the desirable level?**

Levels of Olsen P and Levels of Plant-Available Phosphorus

The Phosphorus for Dairy Farms Project established that, to maintain a vigorous dairy pasture, an Olsen P of 18 to 22 mg/kg is suitable, although lower levels would be satisfactory for lower stocked farms

Olsen P (mg/kg)	Availability
Below 9	Deficient
9 to 14	Marginal
14 to 20	**Adequate**
Above 20	High

DEPI, Victoria, *www.dpi.vic.gov.au/agriculture/dairy/pastures...dairy.../chapter-8*

Total Phosphorus

- **Total Phosphorus (TP)* reports P extracted by hot, concentrated acid and includes unavailable inorganic and organic** forms **of P.**

- **This result is not well correlated to plant available P but does indicate the amount of P in the soil Phosphorus cycle.**

- **Examine the SWEP analysis and enter the total P on your work sheet**

Phosphorus Applications

The following soil textures can be used to indicate the amount of nutrient (kg/ha) above maintenance required to increase the soil fertility by 1 Olsen P unit *.

Sands may need 5 kg P/ha

Sandy loams 8 kg P/ha

Clay loams 10 kg P/ha

Clays/red soils 13 kg P/ha

Peats soils need 16 kg P /ha

To be used with caution

* www.dpi.vic.gov.au/agriculture/dairy/pastures-managemen...

Phosphorus Application

The previous recommendation perhaps does not take into consideration unavailable phosphorus due to a pH 5 or lower.

Would it not be better to adjust pH and increase biological activity to release the bound phosphorus?

A High Total Phosphorus – What Might it Mean?

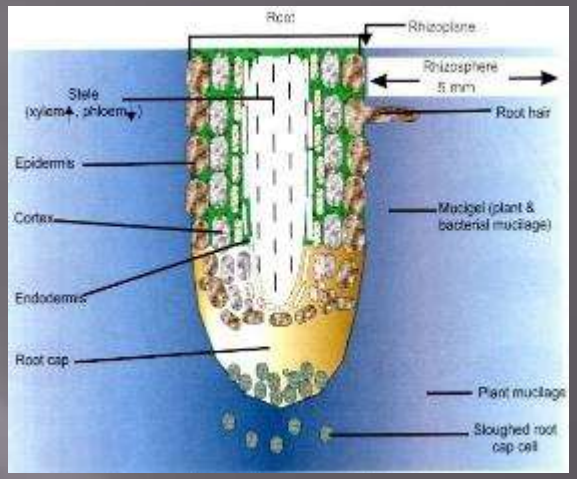
If most Australian soils contain less than 0.02%(200ppm) phosphorus and the SWEP analysis indicates levels of total P at 538ppm,

What might this indicate?

Factors Affecting Phosphorus Availability

- Soil pH
- Soil compaction
- Soil aeration - A lack of adequate soil O_2 can reduce P uptake by as much as 50%.
- Soil moisture
- Soil temperature
- Soil texture – generally low CEC soils have higher soil P tests
- Soil organic matter

Phosphorus Solubilising Microorganisms

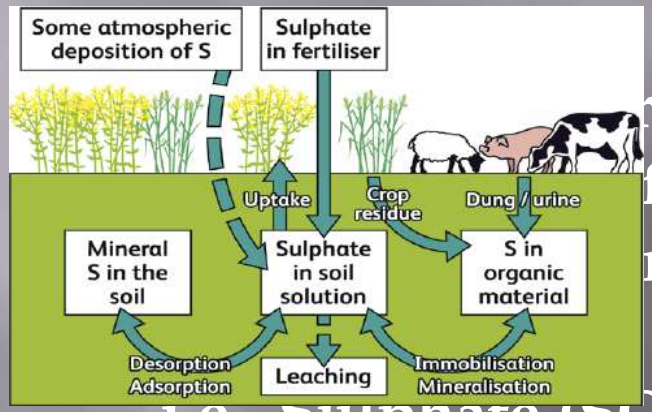


The following bacteria and fungi around the rhizosphere can solubilise inorganic phosphate (Mohammad Saghir Khan, Almas Zaidi, Parvaze A. Wani, 2007)

Phosphate-solubilizing fungi and actinomycetes	Predominant acids
Aspergillus flavus, A. niger, Penicillium canescens	Oxalic, citric, gluconic succinic
Bacillus, Pseudomonas	Gluconic, 2-ketgluconic, oxalic, citric

Sulphur

Remember that humus is an essential storehouse of nutrients, 95% N, 60%P, >70%S



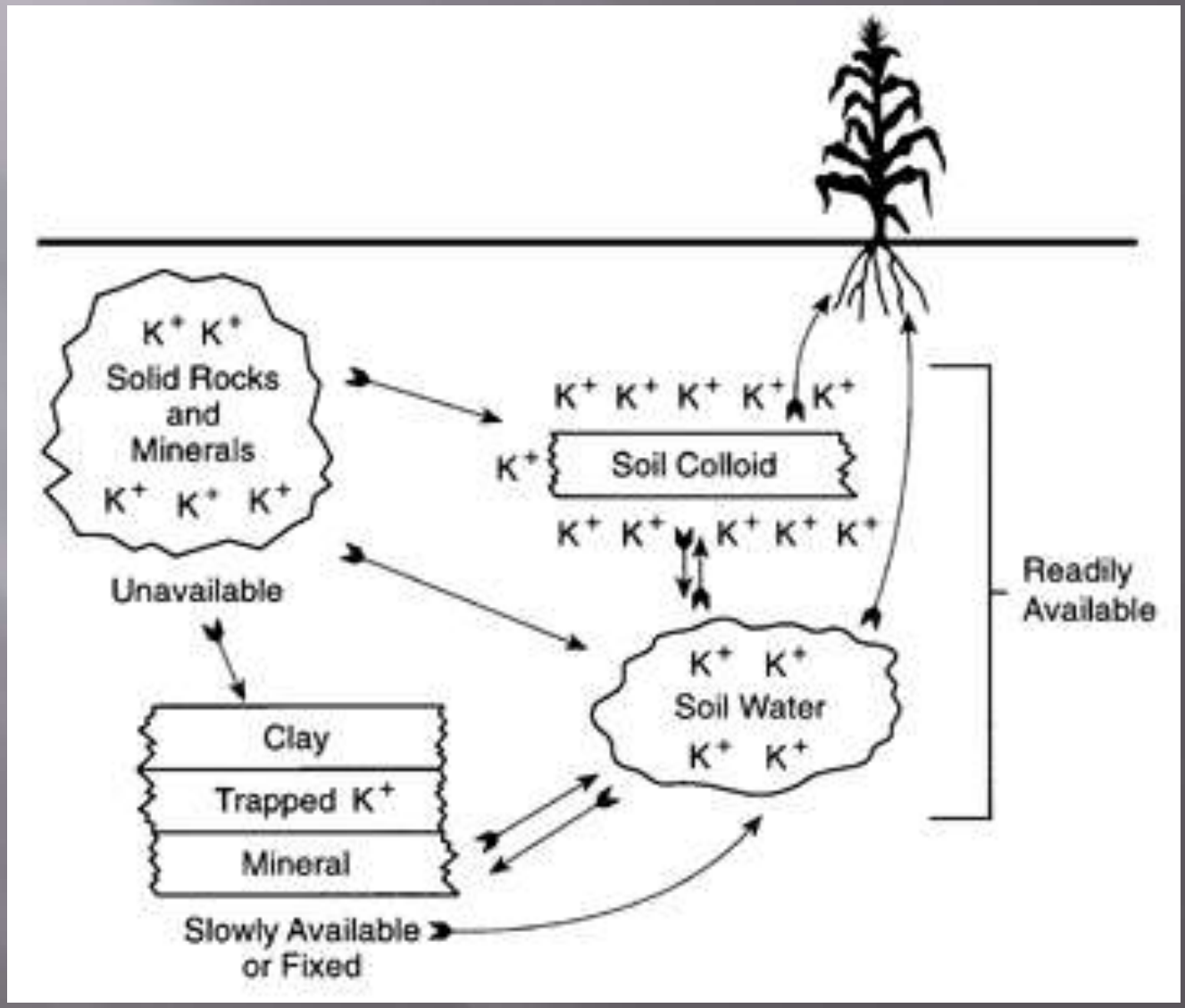
Sulphur like phosphorus is
ed on the positively charged
f iron and aluminium
nly be taken up
an ionic form,
i.e. Sulphate (SO4) is an anion

Enter the sulphur from the Sthn Cross analysis

Available Sulphur

The methodology for extracting sulphur (KCl) takes into account some of the sulphur that will become available from the breakdown of organic matter. This is relevant for dairy pastures, which often have thick root mats and therefore a significant potential to supply sulphur via organic matter breakdown.

Potassium in Soil



Potassium Analysis

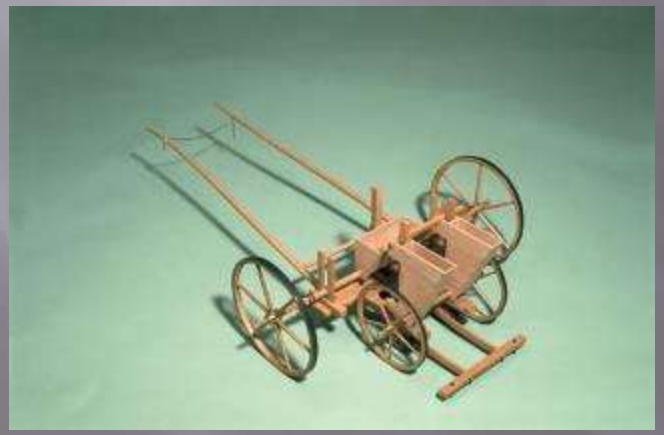
Plant available potassium is measured by several accepted methods or estimated from exchangeable potassium.

Colwell as a vigorous extractant (sodium bicarbonate), or Skene extractant (hydrochloric acid) removes soluble, exchangeable and some fixed potassium. These values are usually reported in milligrams per kilogram of soil (mg/kg). Morgan extractant does not remove quite as much.

Enter on your work sheets the potassium from the Sthn. Cross analysis (Morgan) and the SWEP analysis (available potassium).

Environmental Trivia

What is the association with these images?



Trace Elements

Soil testing interpretation is difficult as critical concentrations vary between soil types and plants, and extraction procedures for elements can vary between laboratories.

Plant tissue testing is the preferred method for diagnosing trace element toxicities, deficiencies, and imbalances for plants.

Research has reported poor correlations between the levels of trace elements measured in soil tests against the responses to trace elements in the paddock.

Trace Elements

The trace elements considered to be essential for plant growth include molybdenum, manganese, iron, copper, zinc, boron, chloride, sodium and cobalt.

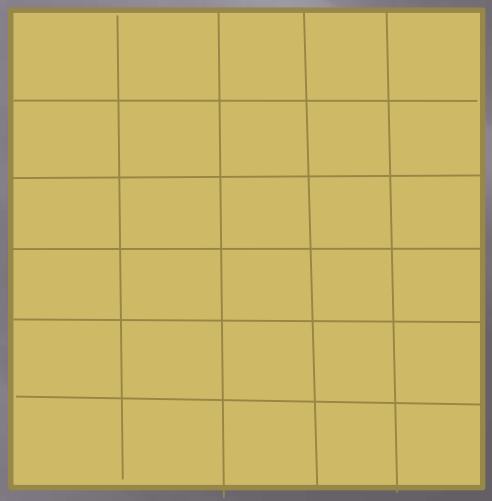
The DPI recommend that clover samples are usually used to diagnose trace element deficiencies in dairy pastures, although ryegrass can be used where it is the dominat species.

Pasture Soil & Tissue Tests

	Soil	Soil		Clover	Clover		Grass	Grass
	Reported	**Desirable**		**Reported**	**Adequate**		**Reported**	**Adequate**
Copper	0.8ppm	1.6ppm		15ppm	6-7ppm		11ppm	6-7ppm
Zinc	2.6ppm	4ppm		43ppm	16-19ppm		43ppm	14-20ppm
Manganese	15ppm	18ppm		164ppm	25-30ppm		168ppm	50-300ppm
Iron	359ppm	18ppm		722ppm	50-65ppm		225ppm	50-60ppm
Boron	0.42ppm	1.4ppm		20ppm	25-30ppm		6ppm	5-15ppm

Soil Crossword

- **Group Work-Prize** for the nearest complete puzzle.



Plant Nutrients

Plants are supplied with nutrients mainly from:

- Soil reserves –geochemistry
- Mineral fertilizers
- Organic sources
- Atmospheric nitrogen through biological fixation
- Aerial deposition caused by wind and rain
- Irrigation, flood or groundwater, and sedimentation
- From runoff.

Nutrient Supply in Agricultural Systems

Sustainable Systems

Feed the soil

Conventional Systems

Feed the plant

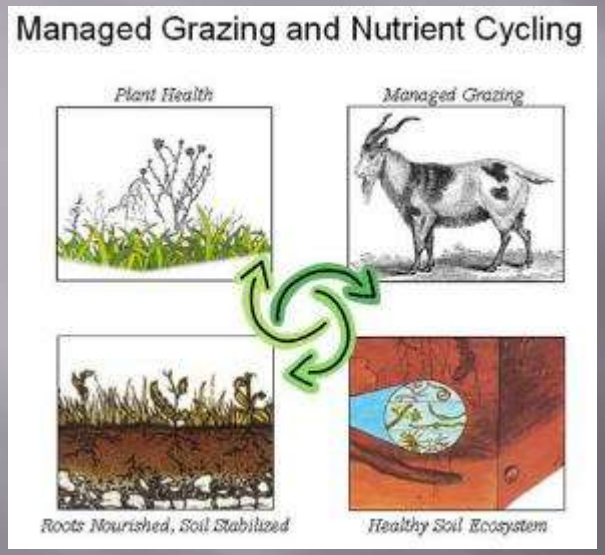
Sustainable Plant Nutrition

Enhance soil productivity through :

- Optimising soil fertility as a basis for nutrient supply
- Addition of mineral and organic fertilizers as indicated by soil/plant analysis and/or production issues
- Is there a need for strategic soil aeration?
- Additions of biological stimulants to further stimulate soil biological activity

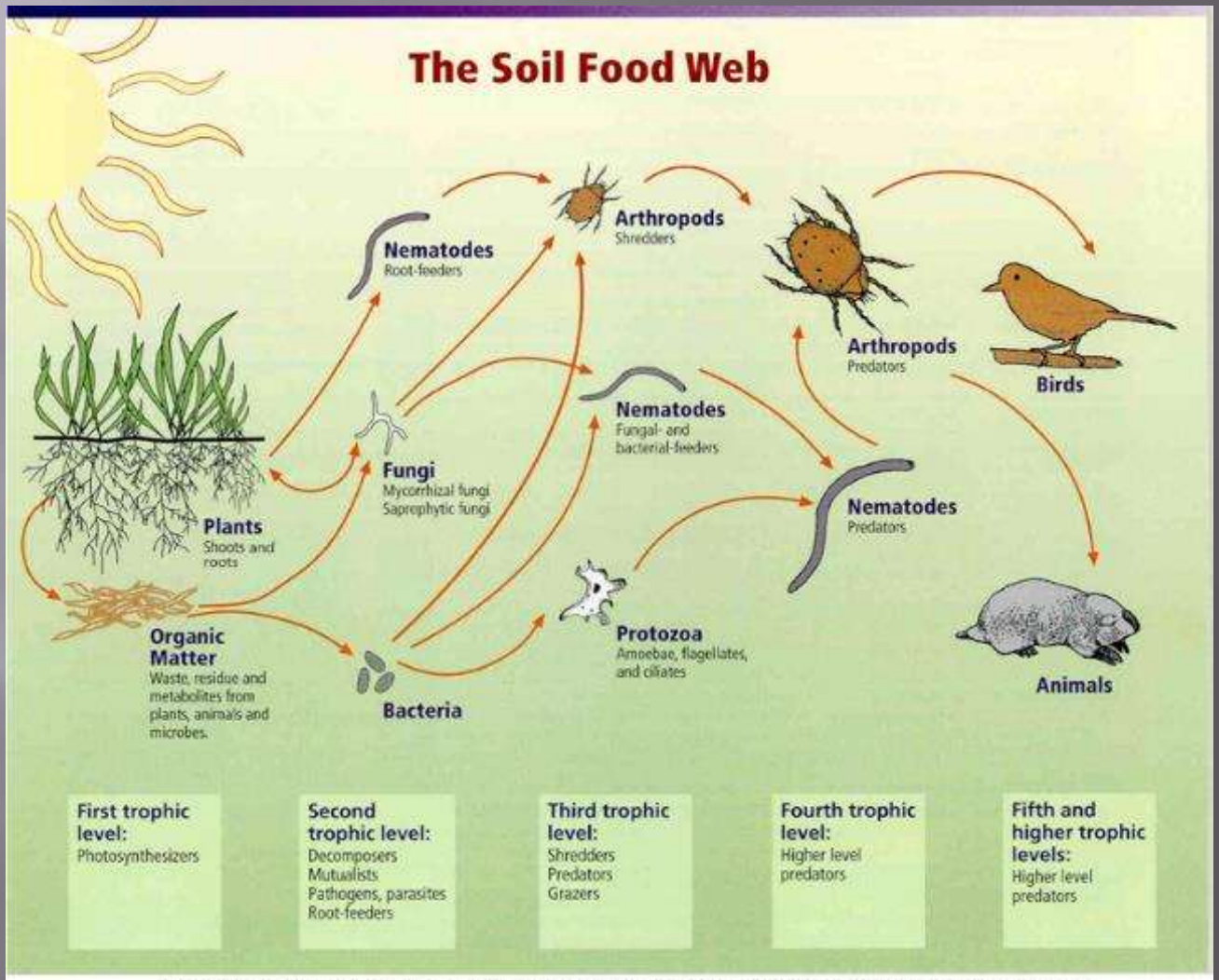
Nutrient Cycling

Nature's recycling miracle



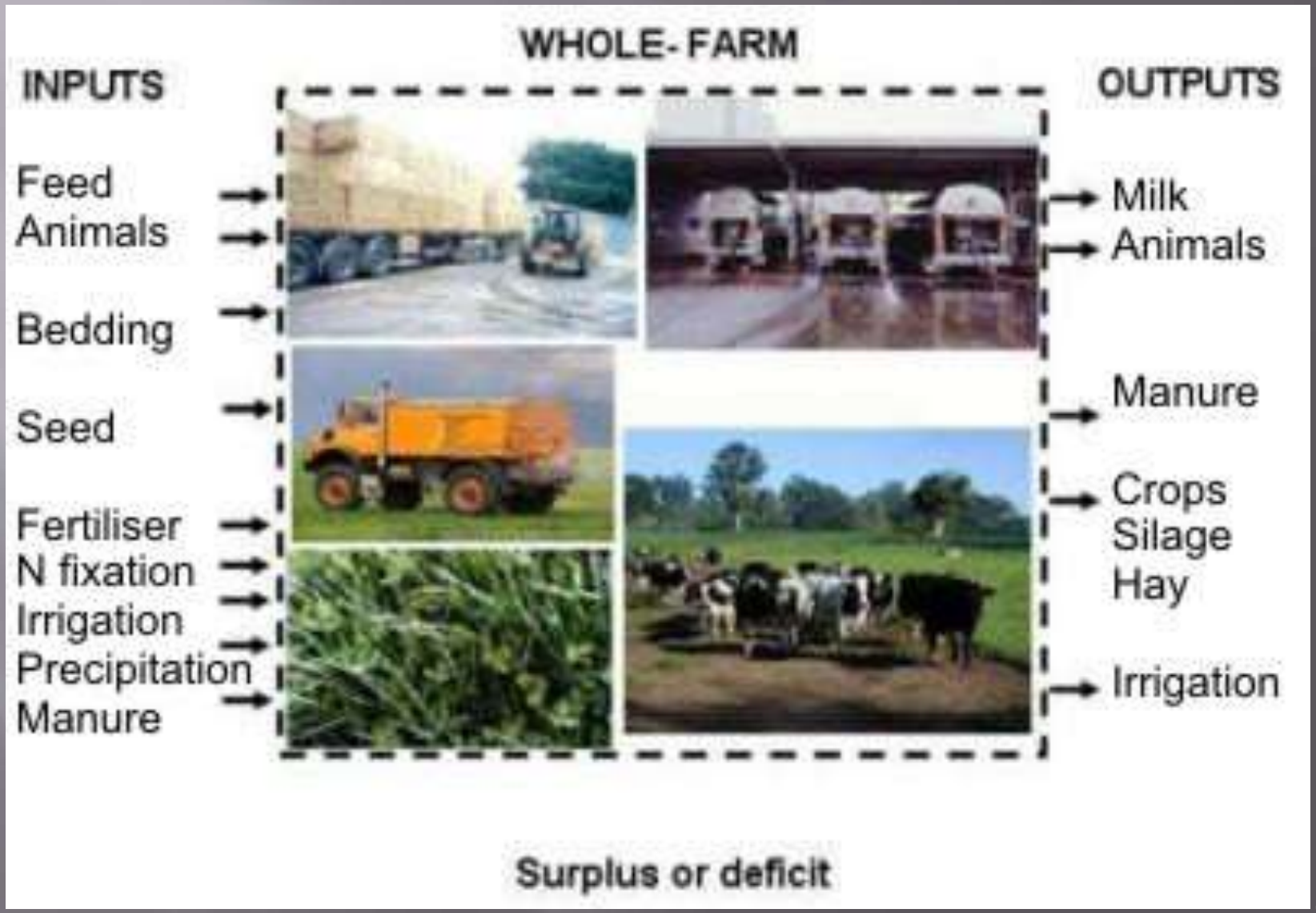
Pasture with cows-urine/excreta cycled 3 times through foliage during the season- Thanks to soil food webs

The Soil Food Web



Relationships between soil food web, plants, organic matter, and birds and mammals
Image courtesy of USDA Natural Resources Conservation Service
http://soils.usda.gov/sqi/soil_quality/soil_biology/soil_food_web.html.

Nutrient Budgeting



Value Your Observations

$154 ++++

$154.00

Discussion

Lunch Break