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PLANT NUTRITION
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Pasture Nutritional Constraints:
are we missing something?

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Perennial Pasture Systems, September 2013.

PPS
PERENNIALPASTURESYSTEMS
MAKING PASTURE GO THE DISTANCE

Nutrition up the ladder……..

Read the pasture &
follow the season

Micros?

Assess N (& S)

Look at P (& K)

<u>Get the pH right</u>

- **Start at the bottom and work up**

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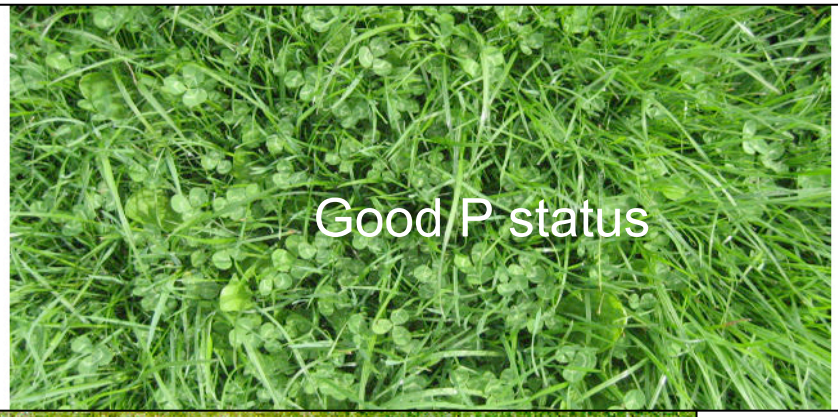


K deficient

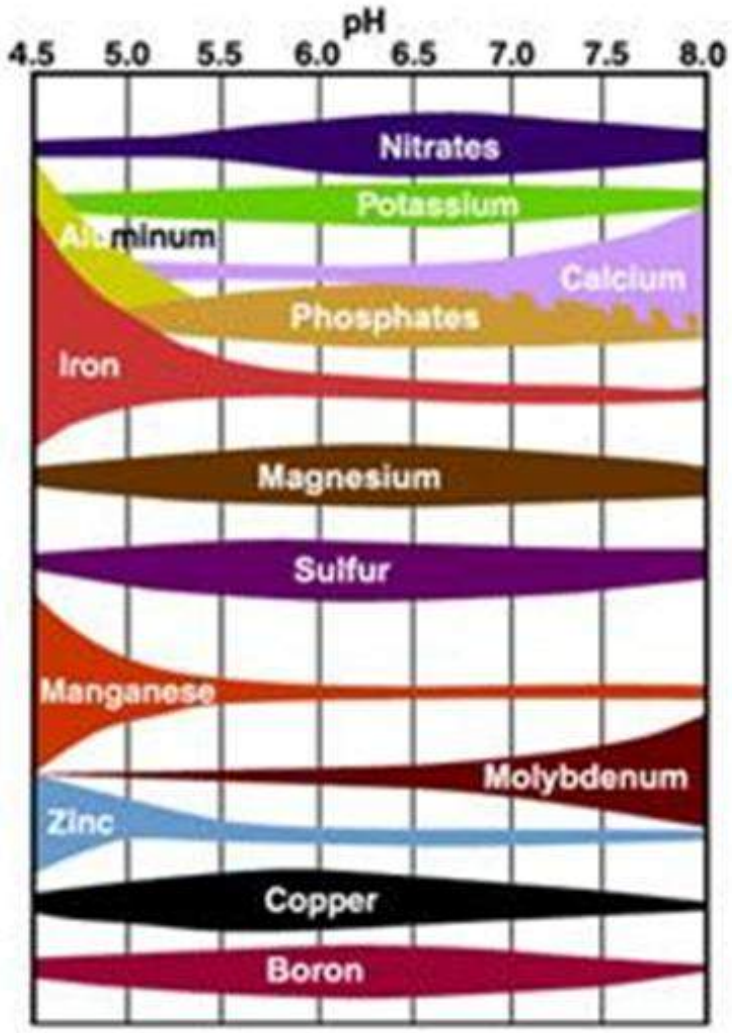
P deficient

A good place to start!

Liming to modify soil acidity (pH_{Ca} <5, exAl>5%)
Gypsum to moderate soil sodicity (ESP>6%)

Soil pH_{Ca} to 4.8 does not matter!?!?! Nutrient availability is the issue

- Soil acidity (pH) drives much of the chemistry in the soil
- Reactions to free or to bind nutrients driven by soil pH
  - Low Mo on acid soils (<5.3)
  - High Al on acid soils (Al>5% not always)
  - High Mn on acid soils (esp. waterlogged).
- Care with B and Zn deficiency after liming – also Mo and liming for Cu.
- Species differ in tolerance to pH
  - Lucerne<Phalaris<PRG+WC<Paspalum
- P fixation, Rhizobia inefficiency.



#1 …….You get nothing for nothing…….

If produce is removed, nutrients go with it – if not replaced, then the soil reserves go down.

This is soil not the "magic pudding".

Removal is relatively low in grazing systems:

	N	P	K	S
Wool *10 DSE/ha @4 kg/hd*	5	0.01	0.6	0.91
Lambs *10 /ha @ 35 kg/hd*	14	3.5	1.3	0.86
Steers *2 /ha @ 350 kg/hd*	18	5.0	1.4	1.01
Wheat *4 t/ha*	85	10.4	14.4	5.6
Oaten Hay *6 t/ha*	78	9.6	102.0	9.6
Lucerne Hay *6 t/ha*	180	12.0	108.0	15.6

BUT – in grazing only systems - need adequate fertility to keep nutrients cycling!

The amount going through the animal is far more important than the amount actually in the animal.

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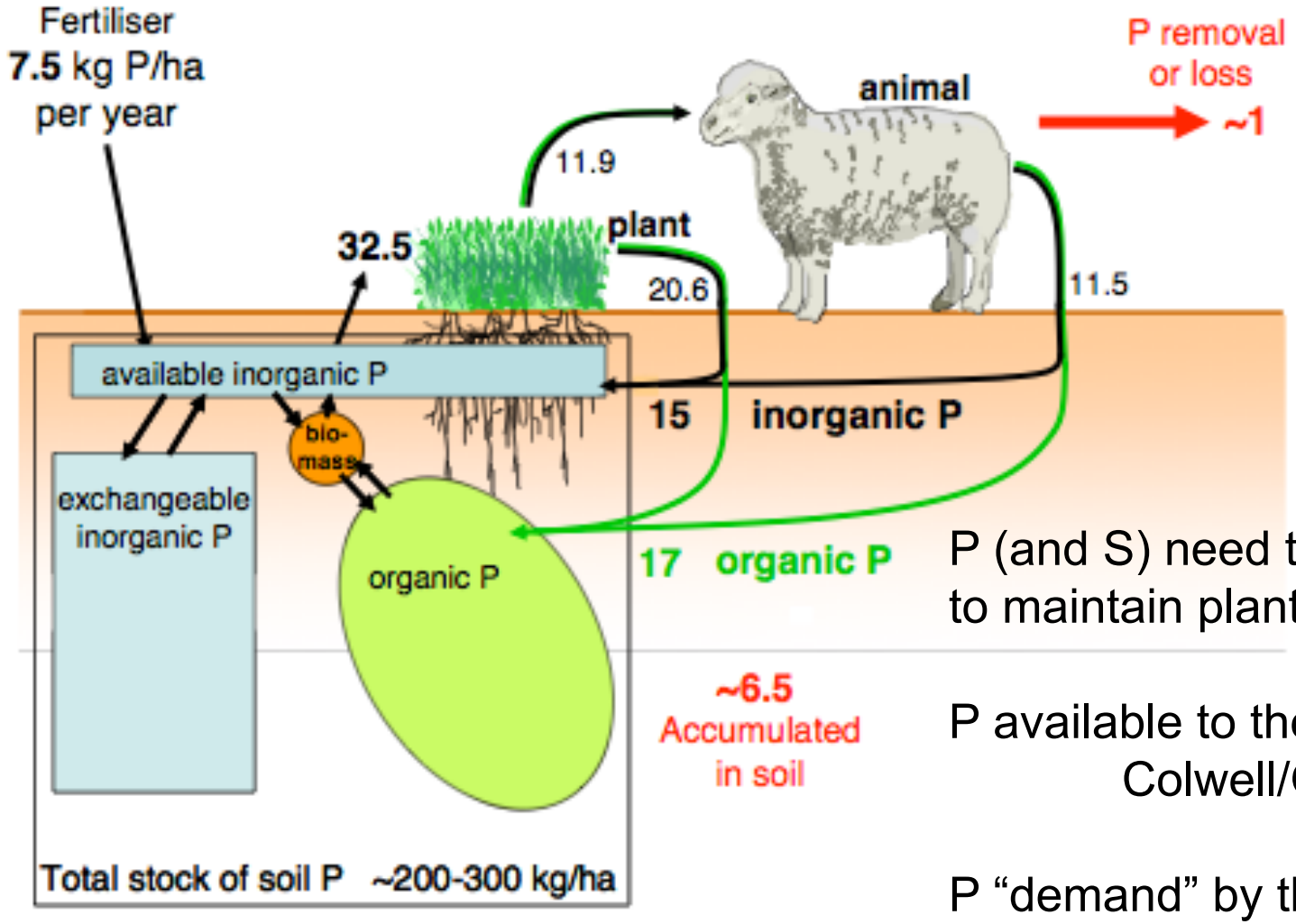
But demand for cycling of P is high



P (and S) need to be cycled to maintain plant productivity.

P available to the pasture
Colwell/Olsen P

P “demand” by the soil
PBI

Using P balance to assist in P decisions

- Maintenance of fertility = keep same DSE and Colwell P

How much is needed to meet the present stocking rate demand?

0.5 kg P/DSE - exported in produce

0.3 to 1.0 kg P/DSE lost through leaching, soil erosion

0.1 kg P/DSE in soil fixation (PBI)

Pasture type/rainfall /grazing system

For example
0.9 kg P/DSE

100 wethers
= 1 t of SSP

- Increase in fertility = increase DSE and Colwell P

How much is needed to raise the test value to meet the extra demand?

Soil test response to added P

- *eg* 100 PBI – 2.7 kg P to raise Colwell 1 unit.
- *eg* 300 PBI – 3.0 kg P to raise Colwell 1 unit.

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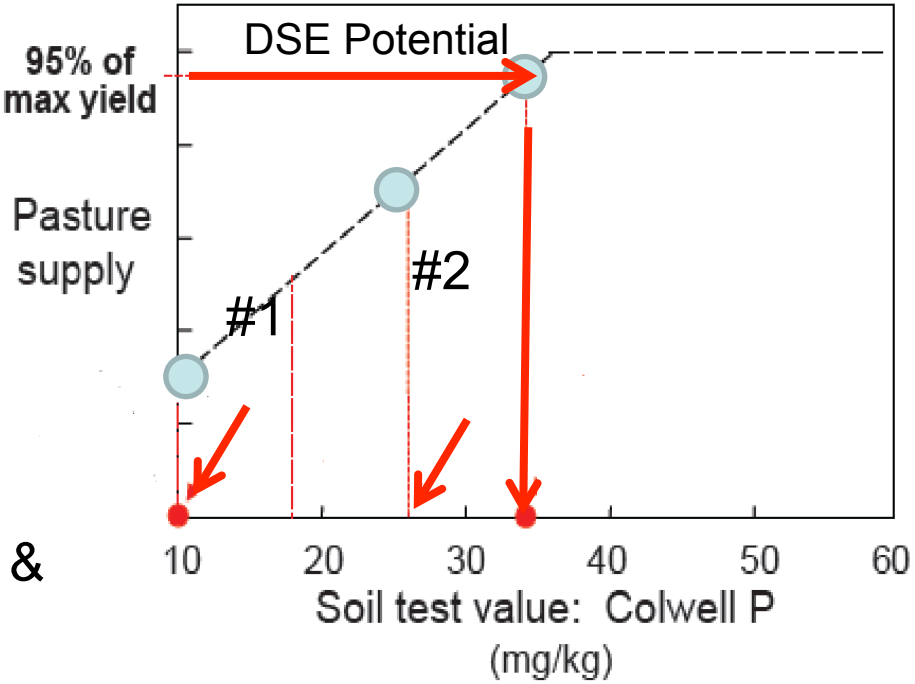
What extra carrying capacity will an increase in soil test value give?

- Derived from stocking rate & P trials
  - unfertilized soil test & stocking rate (#1)
    - 6 DSE & 10 Colwell P
    - ***5.4 kg P/ha (6*0.9)***
  - What is the current soil test & stocking rate (#2)?
    - 10 DSE & 27 Colwell P
    - ***9 kg P/ha (10*0.9)***
  - To move to 14 DSE – requires Colwell of 35 (#3)?

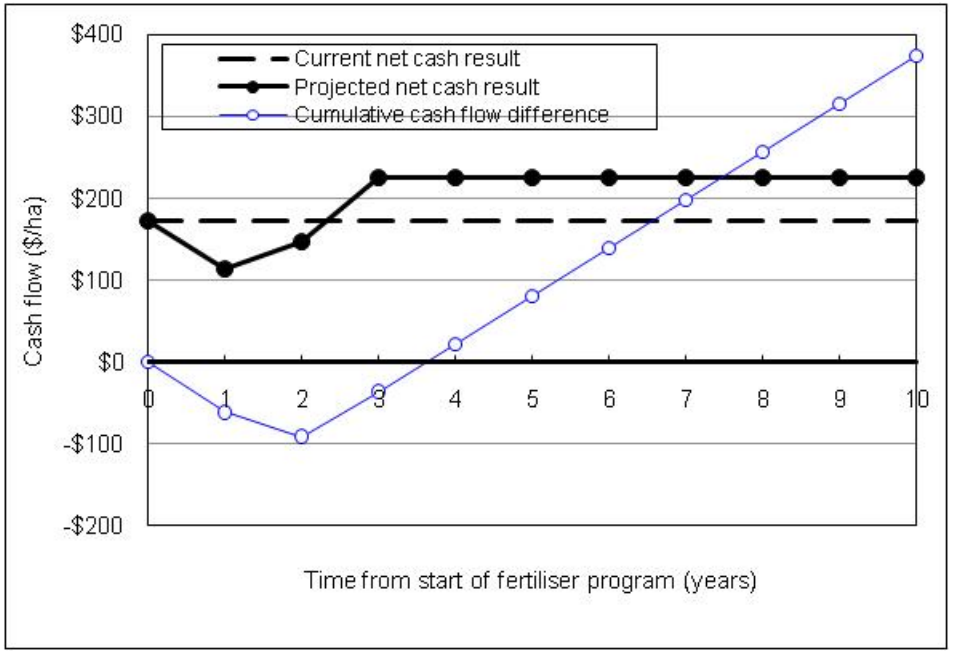


Maintenance 13 kg P/ha + Fertility 24 kg P/ha *(8 units @ 3 P/unit)*

Decide if this will make you any money

- Extra fertilizer
- Extra costs & stock
- Extra production

- Use tools to assist with decision making



Current fertiliser rate (kg fertiliser/ha)	105
Gross margin - current ($/DSE)	$22.00
Gross margin - projected ($/DSE)	$22.00
Capital cost of extra livestock ($/DSE)	$40.00
Fertiliser cost ($/tonne)	$400.00
Fertiliser spreading cost ($/ha)	$5.70
Interest on debt ($)	8.00%
Area of pasture (ha)	100

Soil tests and pasture responses – the top of the curve

- Critical soil test values indicate nutrient limitation operating.
- For example - Olsen P values.
- Response is affected by co-limiting factors
- Interpret critical values with so texture, chemistry.
- For Olsen P:
  - critical P = 15 mg/kg
- Range of 14-17

- *Better Fertilizer Decisions for Pastures*.

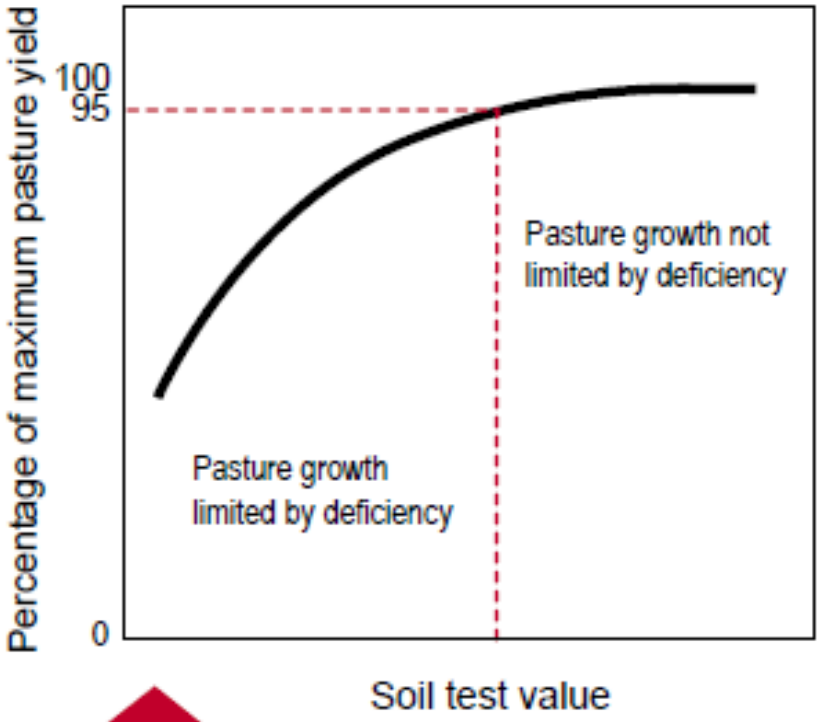


Figure 2.

A generalised calibration relationship between relative pasture production and soil test value.

Colwell P and pasture responses

- A critical P test value depends on soil chemistry – P buffering capacity

- PBI is a measure of how much applied P is transferred to the low availability pools.
- Scale 0 to 1000(+)

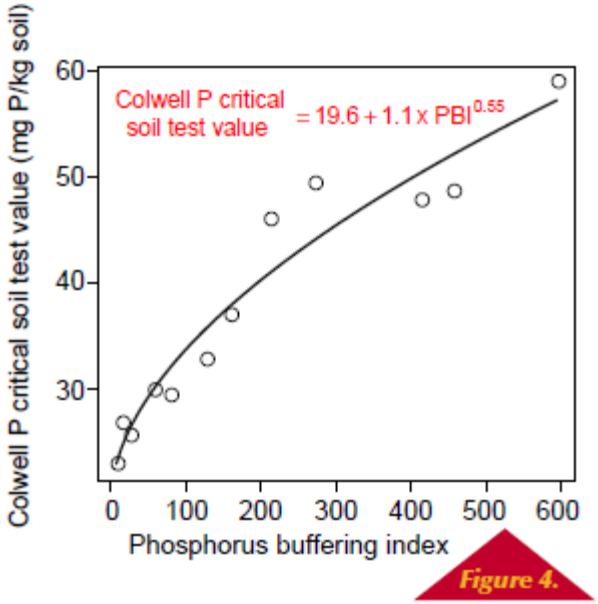


Figure 4.

The relationship between critical Colwell P value and soil P buffering index. The critical Colwell P value is the soil test value predicted to produce 95% of maximum pasture yield.

PBI Category		Critical Range
<15	Extremely Low	20-24
15-30	Very very low	24-27
36-70	Very low	27-31
71-140	Low	31-36
141-280	Moderate	36-44
281-840	High	44-64

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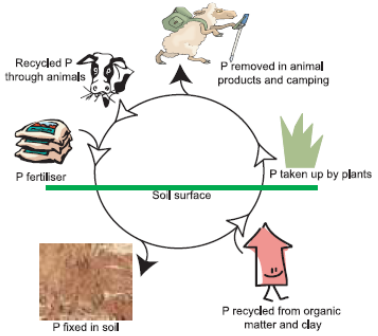
Operating above critical P?



- Is it then worth pushing fertility even above the critical values

- Richard Simpson CSIRO
  - It is relatively inefficient to try to maintain a high soil P test value – relatively more P ends up in low availability P pools

Treatment	P in	P out	P build up
9 dse, nil P	8	5	3
9 dse, soil test 12	53	7	46
18 dse, soil test 12	70	11	59
18 dse, soil test 24	94	13	81

http://www.regional.org.au/au/asa/2010/crop-production/nitrogen-phosphorus/7208_simpsonrj.htm

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#2 …..Address the limiting factor……

- Its no good checking to see if the hydraulic fluid is OK……..
  - What is limiting production – until that is addressed, then no extra response.

How to find out – soil testing…….

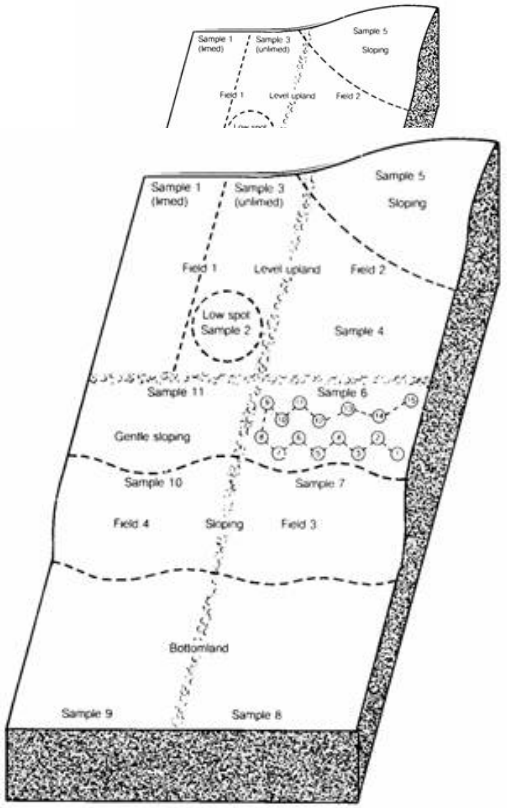
Do it simple – or do it fancy – or get someone to do it.
Just do it!

For P, N and S root depth important!

- 0-30, 0-60 newer calibrations
- Look for deeper samplings as well (subsoil?)

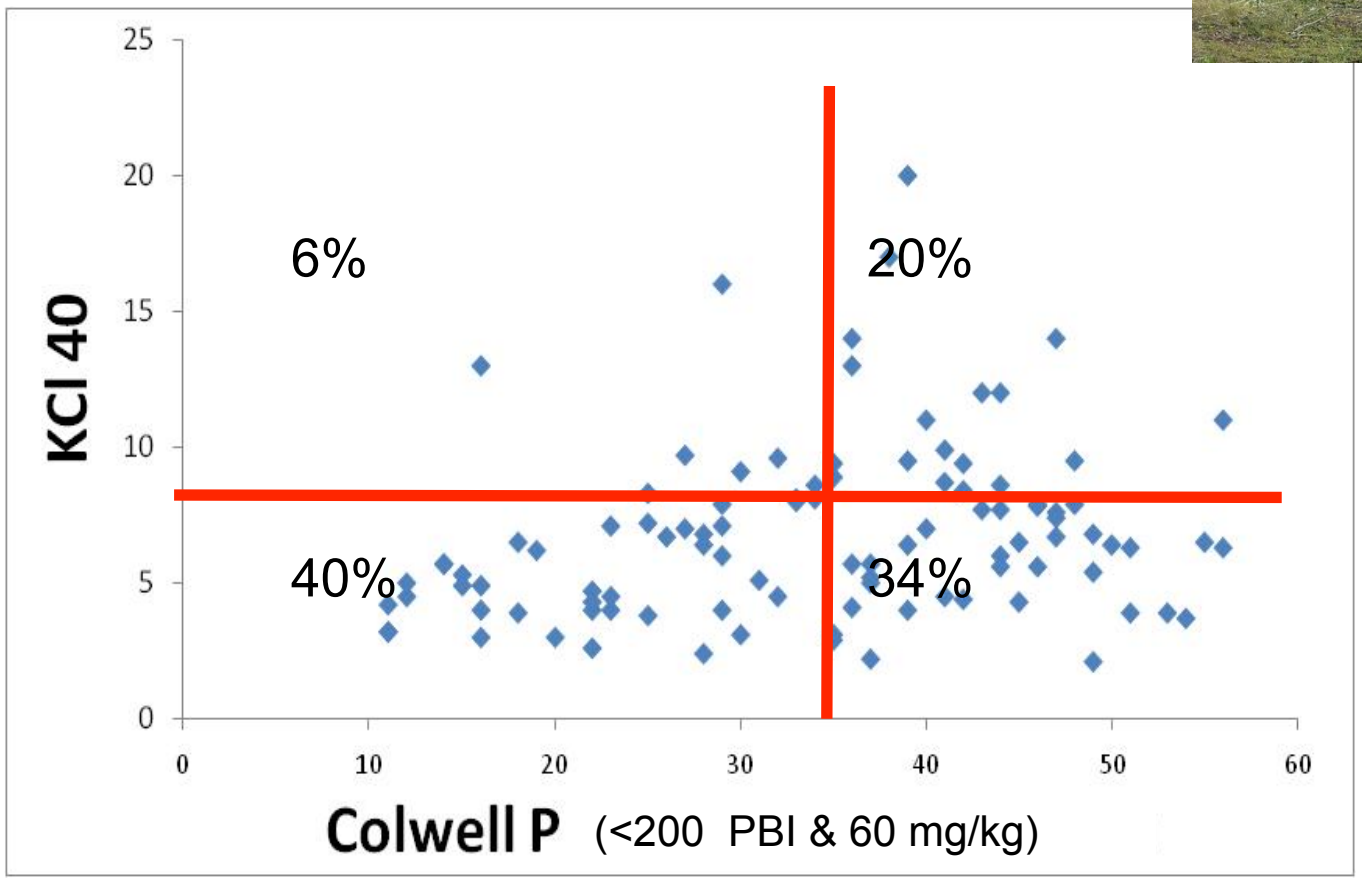
Most soil tests calibrated to 0-10 cm.

Importance of taking good soil samples



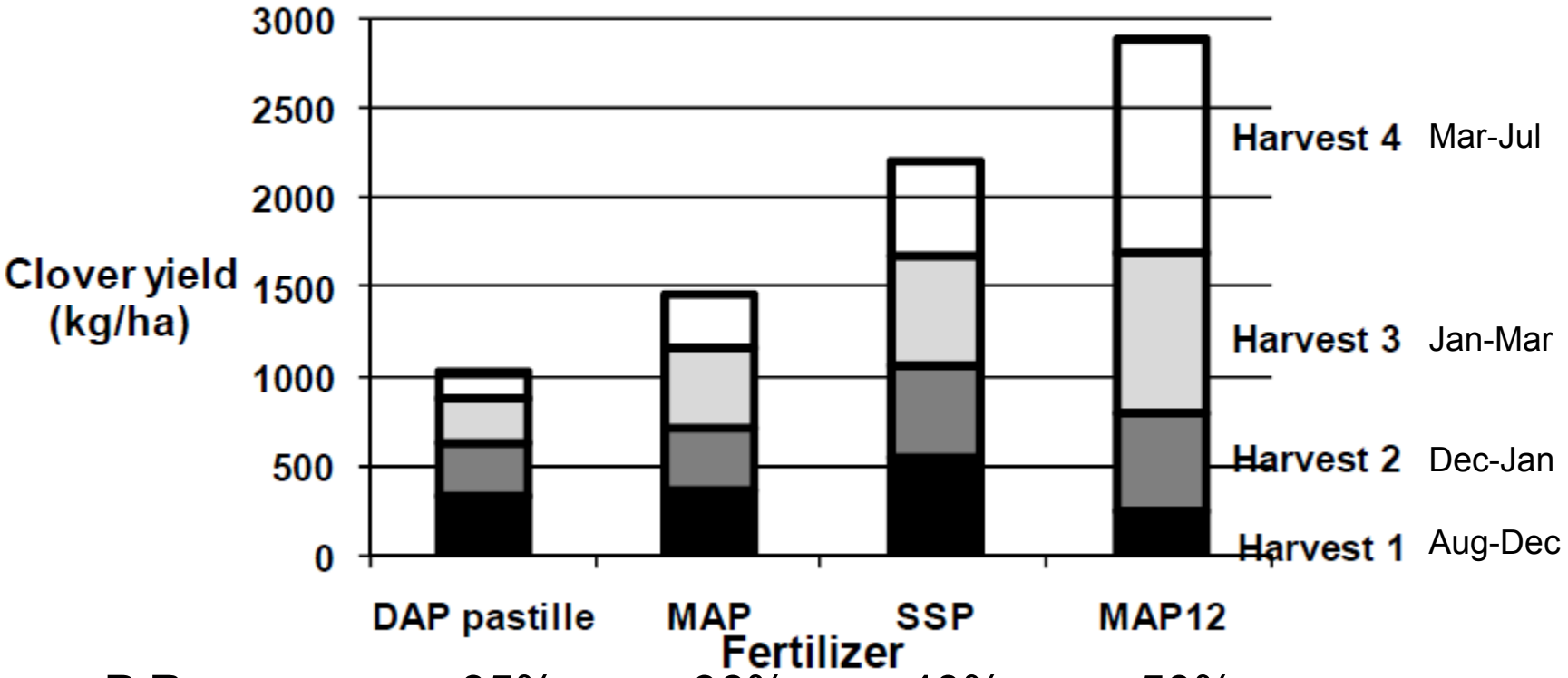
- In the lab, 0.5 g of soil is tested.
- This sample should represent the paddock or area to be managed.
  - Zone, gridded, random? ---- PURPOSE
- Timing about the same time each year.
- Avoid stock camps, gates, etc.
- Take particular care with depth, especially for P.
- Clear away pasture thatch or dry material
- 20 cores mixed then subsampled into sample bags and dispatched ASAP.
- ***Garbage in = Garbage out.***

Assume nothing – variable P, generally low S



Fertilizer responses to P and S

Site has Colwell P of 10 and KCl40 of 1



P Recovery	35%	36%	40%	50%

Source, Flavel, Guppy & Blair, 2010 World Soil Science Congress.
Old Redgrass. Wallaby Grass, Bluegrass, Kangaroo Grass, over sown with sub, white & red clovers. UNE
http://www.iuss.org/19th%20WCSS/symposium/pdf/1926.pdf

Control

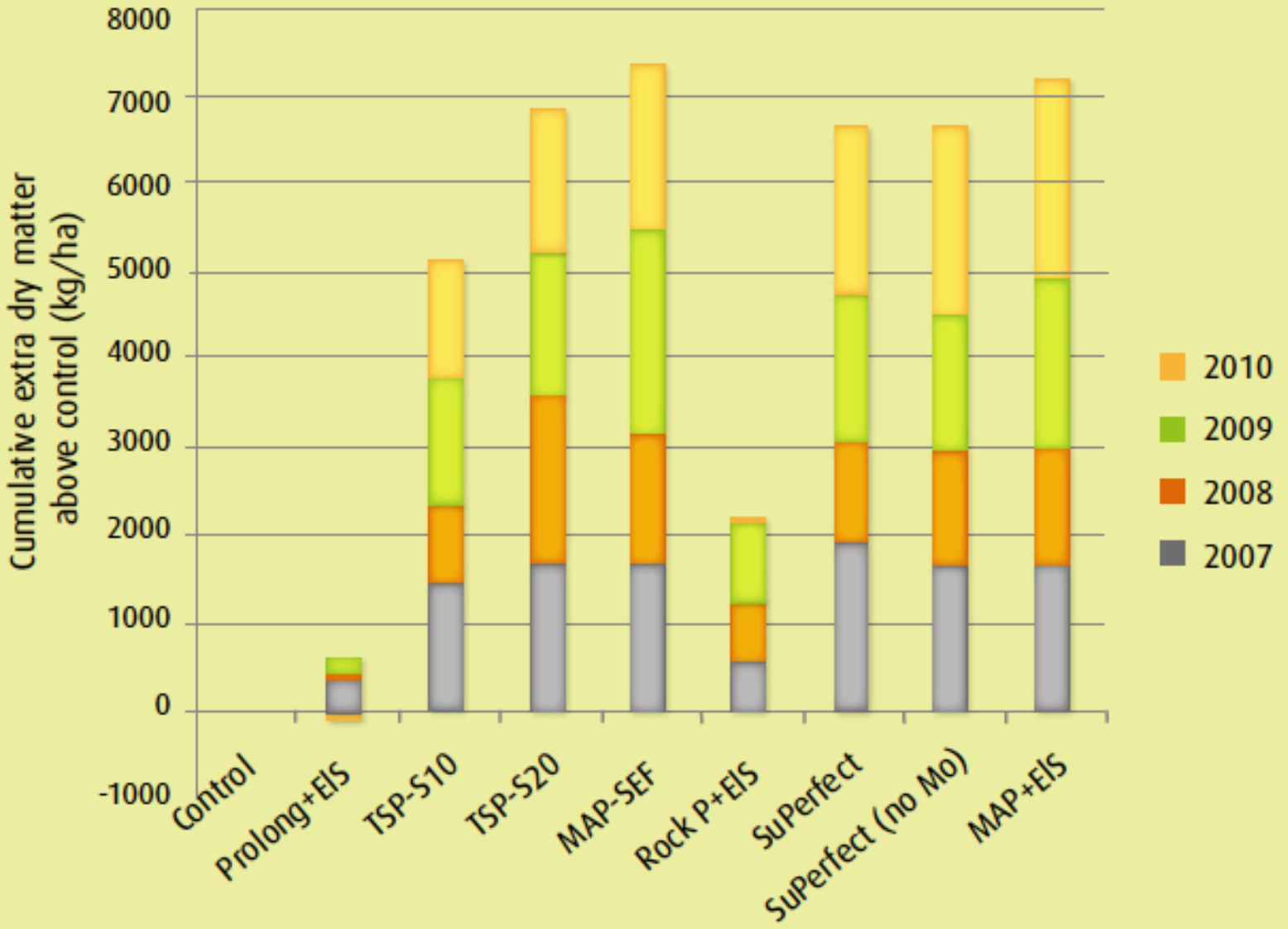
Single superphosphate

MAP

MAP + S^0/SO_4^{2-}

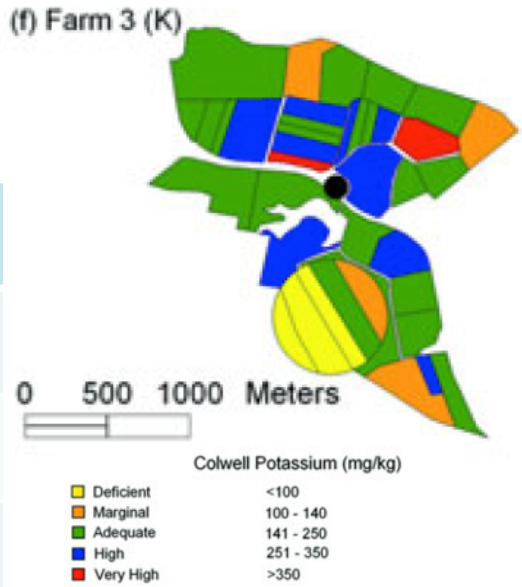
DAP + Pastille S

Cumulative dry matter, Marcus Hill, 2007-2010



Keep an eye on K as well……

Texture	Critical	High	%<CL	%CR	%>High
SL	80 - 130	>250	24%	28%	12%
SCL	90 - 130	>260	20%	25%	18%
CL&C	100 - 150	>280	9%	20%	31%



- Clover in urine patches
- Stock camps & fertility grades
- Tissue tests can be useful
- Test strips can be useful

Pasture test strips

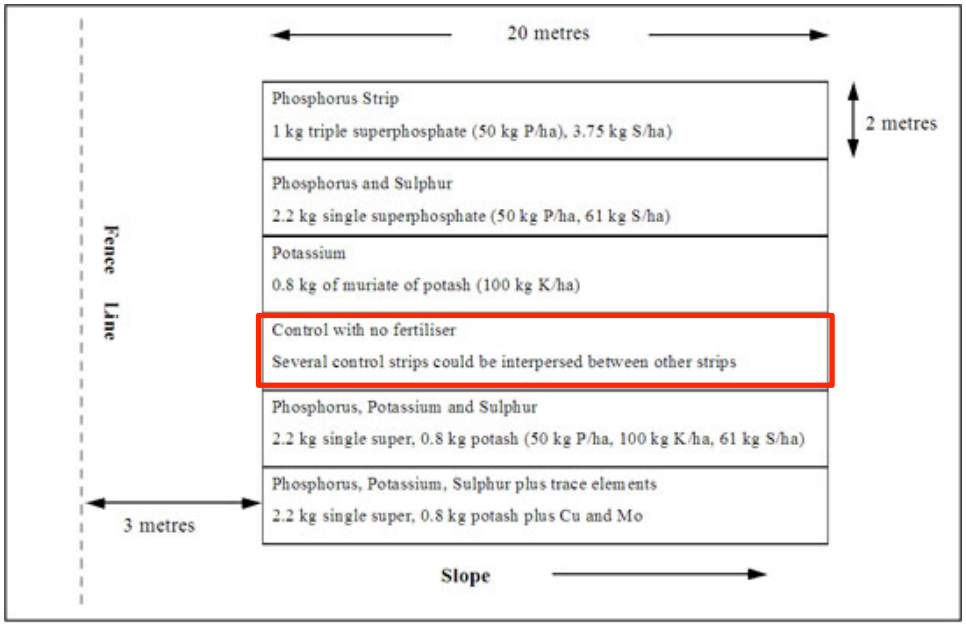


Figure 1. Typical fertiliser test strip site plan

- Set up on typical species/soil types.
- March to July – preferably before spreading
- Away from fence lines, drainage lines, stock camps.
- Machine or hand spread
- Monitor growth, height, composition, evenness

http://new.dpi.vic.gov.au/notes/crops-and-pasture/fertilisers-for-pastures/ag0204-using-fertiliser-test-strips-on-pasture

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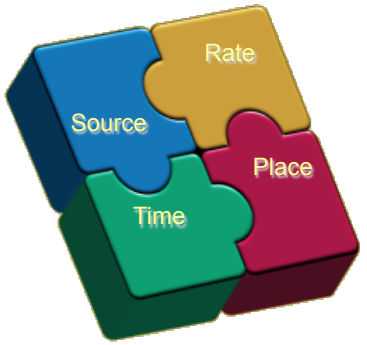
Where will N give a benefit?

- When soil N supply is low and temperature & water not limiting.
  - Late winter/early spring (slow clover growth).
- If the pasture is grass dominant eg PRG, SRRG, ARG.
- When you need the feed.

- N is N
  - Around 20-30 kg N/ha per application
  - Delay feeding (nitrate esp. cloudy).
  - Losses with different products
    - Conditions, Cover, Soils.

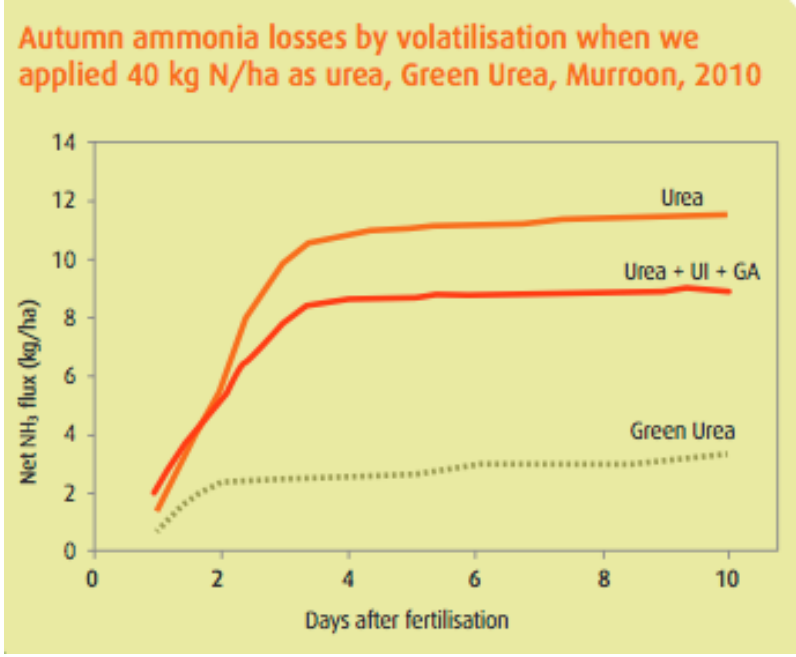
Ammonia losses?



- Losses up to 30% - top-dressed urea
  - Met. conditions
  - Urease Inhibitor – 5% loss
  - Polymer coating – 50-2% loss
  - UAN – 15% loss (half of the N is urea)
  - Urea (20-30%), AmSul (5-10%)

  (Bishop and Manning, 2011)

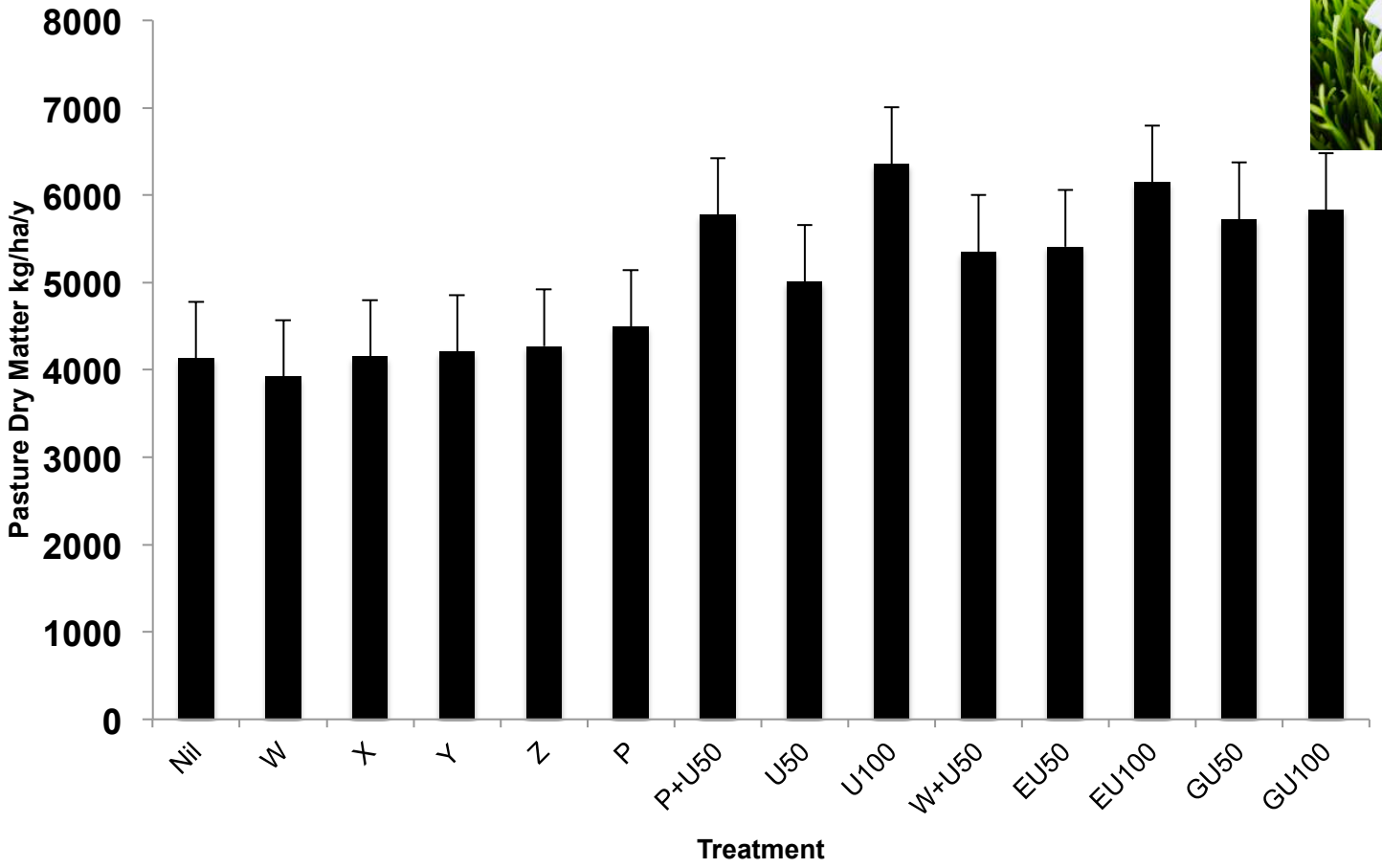
- Degree of loss depends on conditions after spreading!



#3 …….. There are no silver bullets…….

"Frankly, I don't know what to believe. They say if it sounds too good to be true, it usually is."

Are we missing something?



Griffiths et al. 2012. – 2 year mean pasture growth – PRG/Kikuyu NSW Coastal Dairy
http://www.regional.org.au/au/asa/2012/pastures/7949_griffithsn.htm#TopOfPage
Hollingsworth K. 2012. Biological agents review. NSWDPI.

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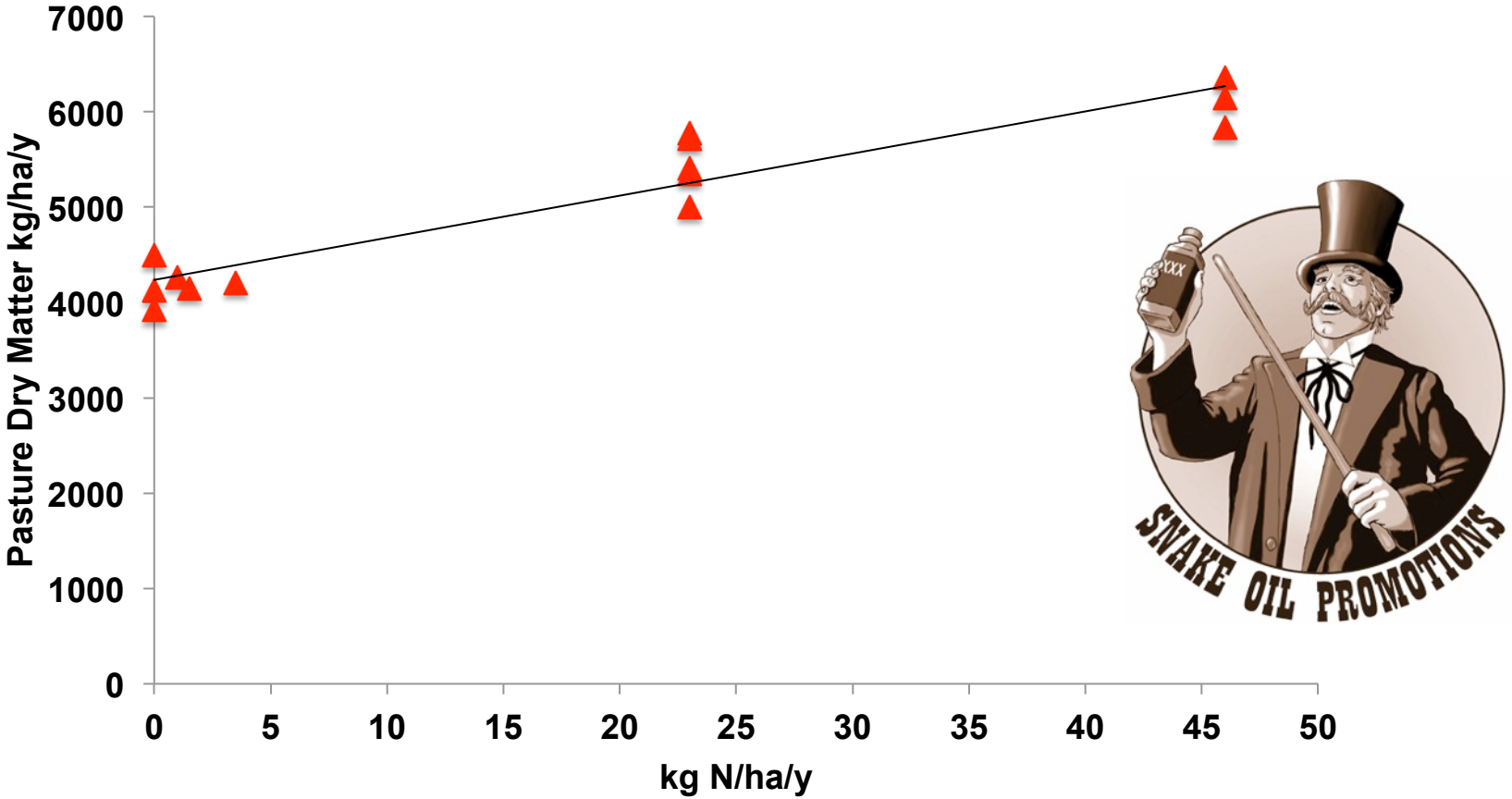

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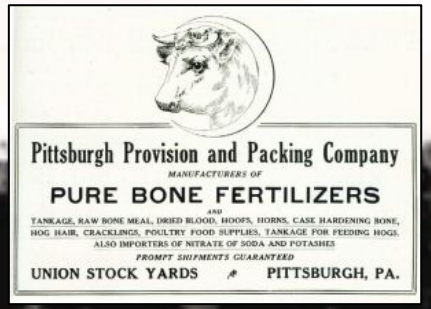
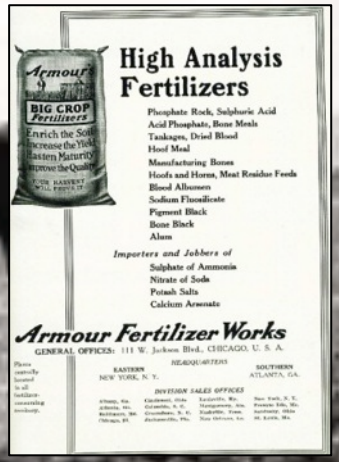
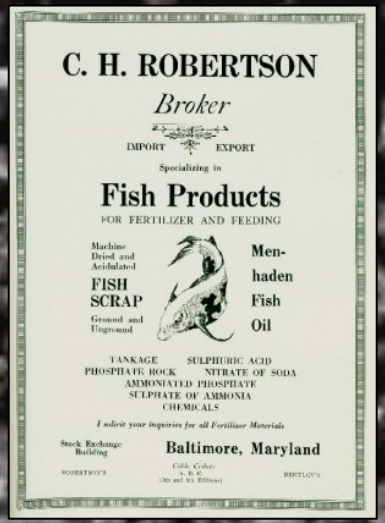
What about Micronutrients?

New/Old Products

- Does it make sense
  - Mass balances?
  - Magic or special?
  - Laws of physics/chemistry
- Evidence from Trials
  - Where
  - When
  - Controls
  - Replicated
- Test it yourself, be sceptical – its your $.

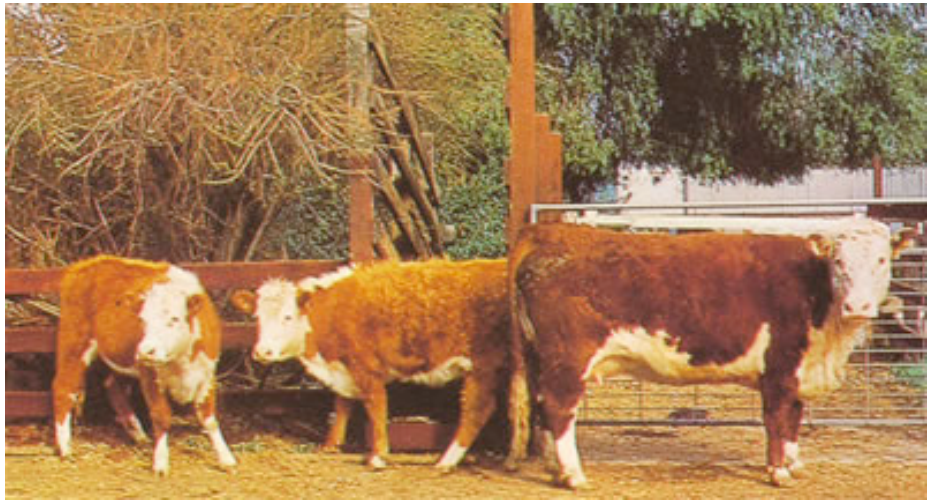






Sometimes seen more in stock than in pastures……

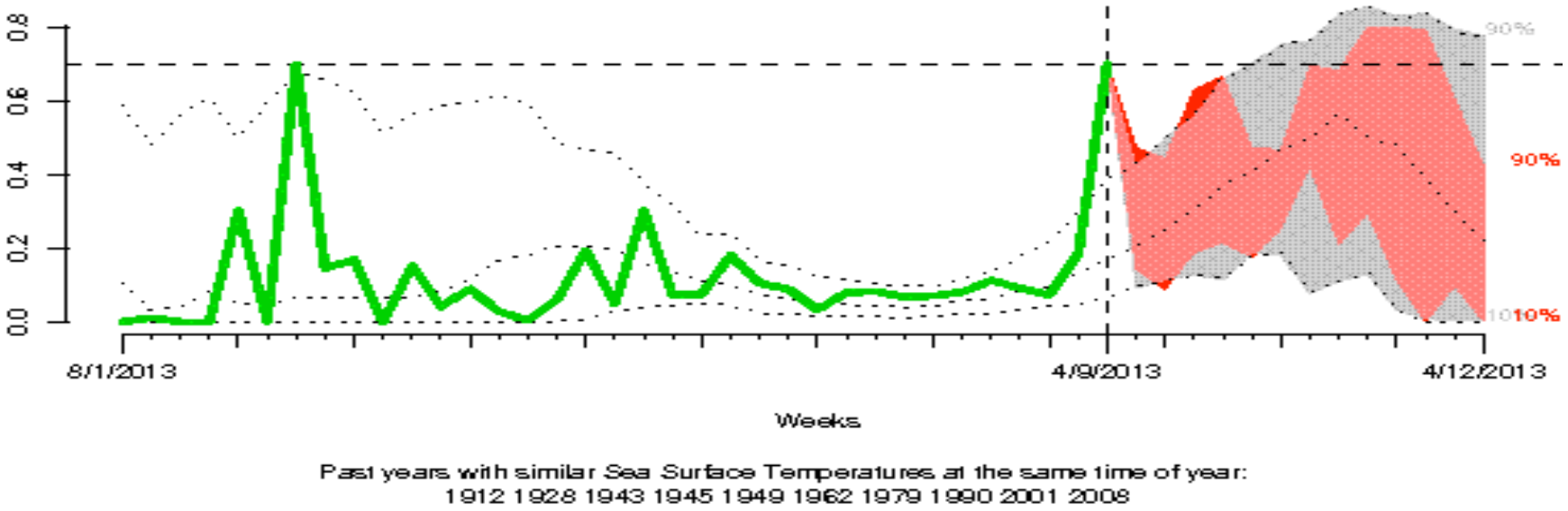
Copper deficiency



Special note about pasture nutrition

Use it ……. or loose it!

Only grow it if you have a use for it?



Pasture growth index for Moyston, Jan-Sep 2013.

MLA Rainfall to Pasture Growth Outlook Tool -

Summary

- Balanced nutrition is important for productive pastures.
- Work from the bottom up the ladder.
- Allocate fertilizer dollars to the most responsive areas.
  - Pasture test strips help identify responsive areas
  - Soil tests help identify responsive areas

- Maintain a soil P test near the value that supports the stocking rate.
- Use tools available to help think through the options.
- There are no silver bullets.

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