NSW GOVERNMENT Department of Primary Industries

Soil Test Interpretation

Nigel Phillips
NSW DPI Wagga Wagga

What are the 16 major and minor nutrients essential for plant growth?

- Carbon
- Hydrogen
- Oxygen
- Nitrogen **MAJOR**
- Manganese
- Zinc
- Sulphur **MAJOR**
- Molybdenum
- Magnesium **MAJOR**
- Iron
- Phosphorus **MAJOR**
- Copper
- Potassium **MAJOR**
- Boron
- Chlorine
- Calcium **MAJOR**

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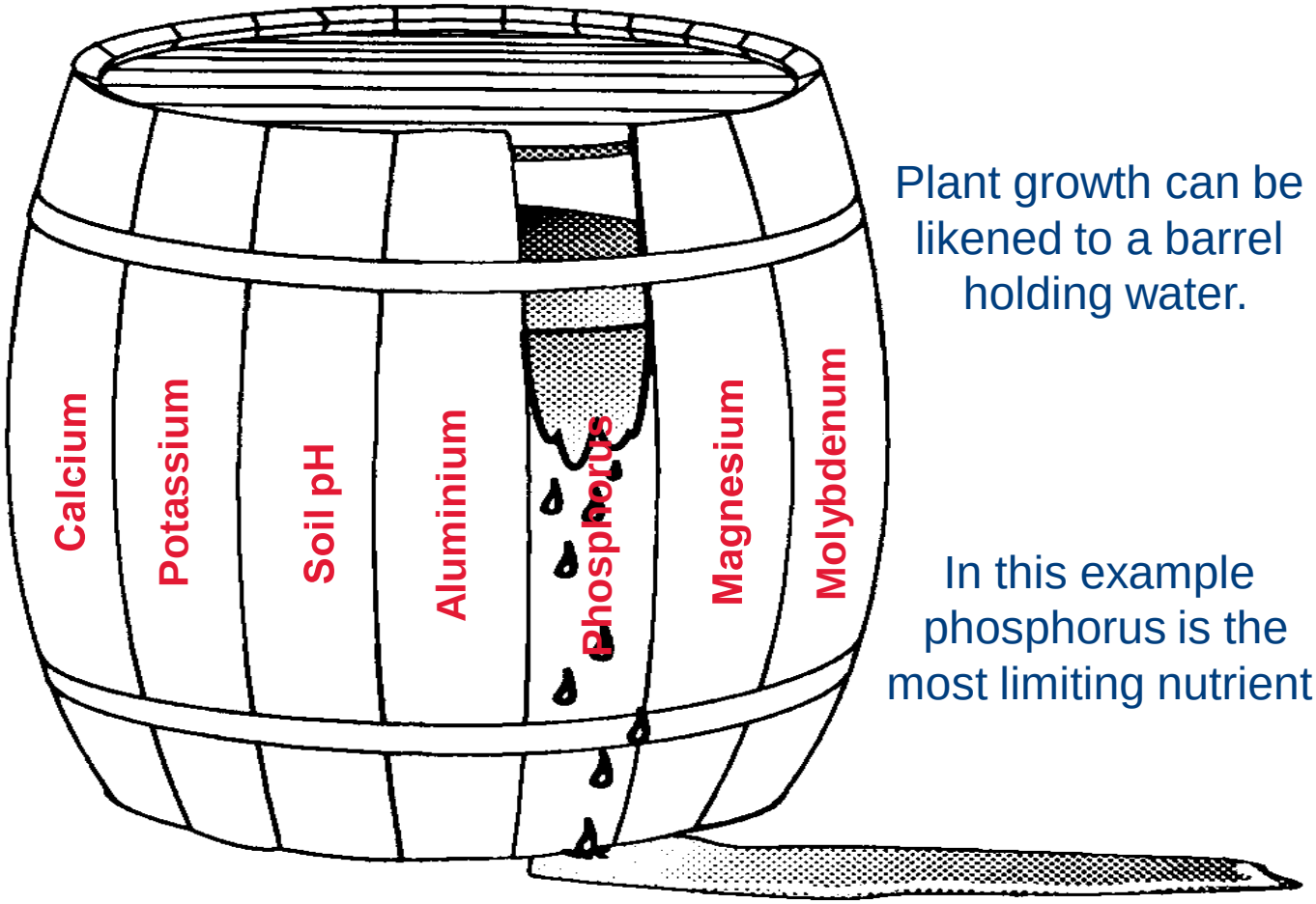
The Law of the Minimum



Plant growth can be likened to a barrel holding water.

In this example phosphorus is the most limiting nutrient

SOIL ANALYSIS REPORT

Nutrient Advantage

ASPAC

Report Number: 376659

NSW Dept Primary Industries
PO Box 798
COOMA
NSW 2630

NATA
ACCREDITED FOR TECHNICAL COMPETENCE

Paul Kennelly
Laboratory Coordinator

Registered Signatory

NATA Accredited Laboratory
Number: 11958

Sample Number:	020942097	**Paddock Name:**	TOOMA ROADSIDE	**Date Sampled:**	21-May-2010
Test Code:	A14	**Sample Name:**		**Date Received:**	27-May-2010
Purchase Order No:	FERGUSON TUMUT	**Sample Depth:**	0 to 10	**Date of Report**	3-Jun-2010
Grower Name:	NATHAN FERGUSON				

Analyte	Result	Units	Method Code	Comments
Colour	Brown		04-042-PHYS	Munsell
Texture	Sandy Loam		04-042-PHYS	Field texture, Northcote (1984).
pH (1:5 Water)	5.4		04-031-PH	1:5 soil/water
pH (1:5 CaCl2)	4.5		04-031-PH	1:5 soil/0.01M CaCl2
Organic Carbon	1.3	%	04-018-UV1	Walkley & Black (1947)
Nitrate Nitrogen	8.9	mg/kg	04-052-SNO3CL	Water extraction
Sulphate Sulphur (KCl40)	4.4	mg/kg	04-021-ICP2	0.25M KCl at 40°C
Phosphorus (Colwell)	16	mg/kg	04-013-COL_P	0.5M NaHCO3 (pH 8.5)
Potassium	0.29	meq/100g	04-026-ICP8	Ex. Cat. Ammonium Acetate (pH 7.0)
Calcium	1.1	meq/100g	04-026-ICP8	Ex. Cat. Ammonium Acetate (pH 7.0)
Magnesium	0.53	meq/100g	04-026-ICP8	Ex. Cat. Ammonium Acetate (pH 7.0)
Aluminium	0.27	meq/100g	04-027-ICP9	Ex. Cat. 1M KCl
Sodium	0.096	meq/100g	04-026-ICP8	Ex. Cat. Ammonium Acetate (pH 7.0)
Chloride	19	mg/kg	04-052-SNO3CL	Water extraction
Elect. Conductivity (EC)	0.05	dS/m	04-031-PH	1:5 soil/water
Copper	1.1	mg/kg	04-024-ICP6	DTPA
Zinc	55	mg/kg	04-024-ICP6	DTPA
Manganese	17	mg/kg	04-024-ICP6	DTPA
Iron	230	mg/kg	04-024-ICP6	DTPA
Boron	0.19	mg/kg	04-025-ICP7	Hot 0.01M CaCl2
Ammonium Nitrogen	2.3	mg/kg	04-043-AMMONIUM_N	2M KCl
Cation Exch. Cap. (CEC)	2.29	meq/100g	04-026-ICP8	Calculation
Calcium/Magnesium Ratio	2.1		04-026-ICP8	Calculation
Elec. Cond. (Sat. Ext.) ^	0.5	dS/m	04-054-WCALC	Calculation
Aluminium % of Cations	12	%	04-026-ICP8	Calculation
Sodium % of Cations (ESP)	4.2	%	04-026-ICP8	Calculation
Phosphorus Buffer Index	52		04-020-ICP17	Calculation, using Colwell P (PBI)
Dispersion Index	2		04-041-PHYS2	Loveday & Pyle (1973)
Slaking	Water Stable		04-041-PHYS2	Visual assessment (2 & 20 hours)

Nutrient Advantage Laboratory Services
Nutrient Advantage is a registered trademark of Incitec Pivot Ltd
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Toll-free: 1800 803 453 Fax: (61 3) 9974 0899
Enquiry: lab.feedback@incitecpivot.com.au

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Nutrients Removed in Products

PRODUCT	NUTRIENTS REMOVED				
	Nitrogen	Phosphorus	Potassium	Sulphur	Calcium
1 beast (500 kg) or 10 lambs	11	3.5	1	1	10
1 bale of wool (200 kg greasy)	27	0.06	3.5	5.5	0.25
1 ton pasture hay	25	2.5	17	2.5	5
1 ton cereal grain	20	3	4	2	3
Uneven Distribution					
1 ton of dung	30	7	13	4	20

1 dry sheep = 146 kg dung/year; 25% deposited in sheep camps

What values on a per hectare basis?

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Nutrients Removed /ha in Products

PRODUCT/ha @ 10 dse/ha	NUTRIENTS REMOVED/ ha @ 10 dse/ha				
	Nitrogen	Phosphorus	Potassium	Sulphur	Calcium
500 kg liveweight	11	3.5	1	1	10
50 kg wool	7	0.015	0.9	1.4	0.06
4 t pasture hay	100	10	70	10	20
5 t cereal grain	100	15	20	10	15

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Uneven Distribution of Nutrients in Dung
25 ha sheep paddock

Re-distribution /ha @ 10 dse/ha	Uneven Distribution to Camps				
	Nitrogen	Phosphorus	Potassium	Sulphur	Calcium
1 ha gets 9 t dung from 25ha paddock	270	63	117	36	180
24 ha gets about 27 t (1.1 t/ha)	33	8	14	4	22
Even distribution	44	10	19	6	29

At 10 dry sheep/ha 1.46 tonne dung/ha/year is produced
If 25% deposited in sheep camps - only 4% of paddock gets 9t/ha
Therefore 96% (24 ha) only gets 1.1 tonnes/ha

Question - should sheep camps receive fertilizer?

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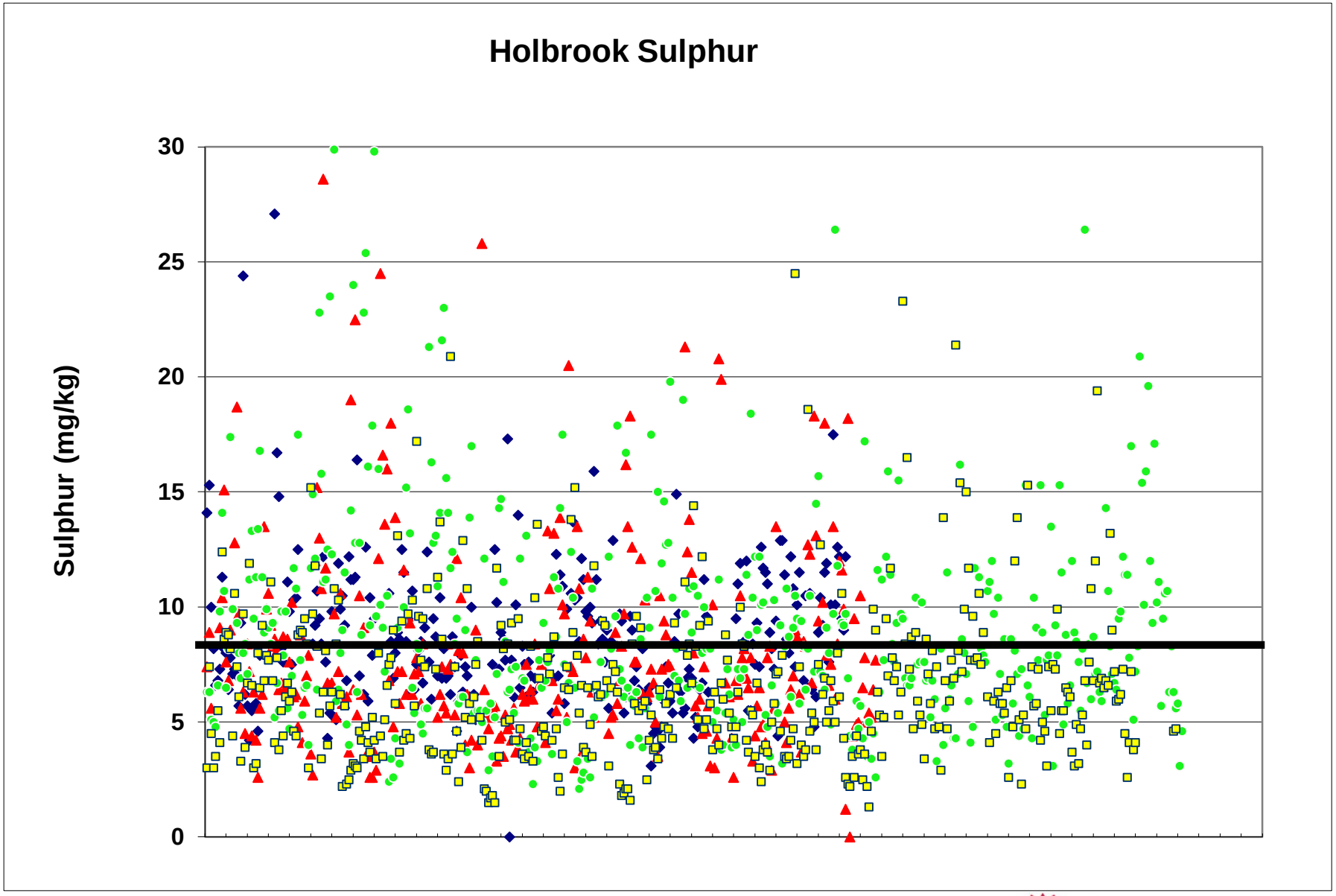
- Sulphur

Potassium

Organic carbon

Electrical conductivity

Soil pH



Critical Value = 8 BFD

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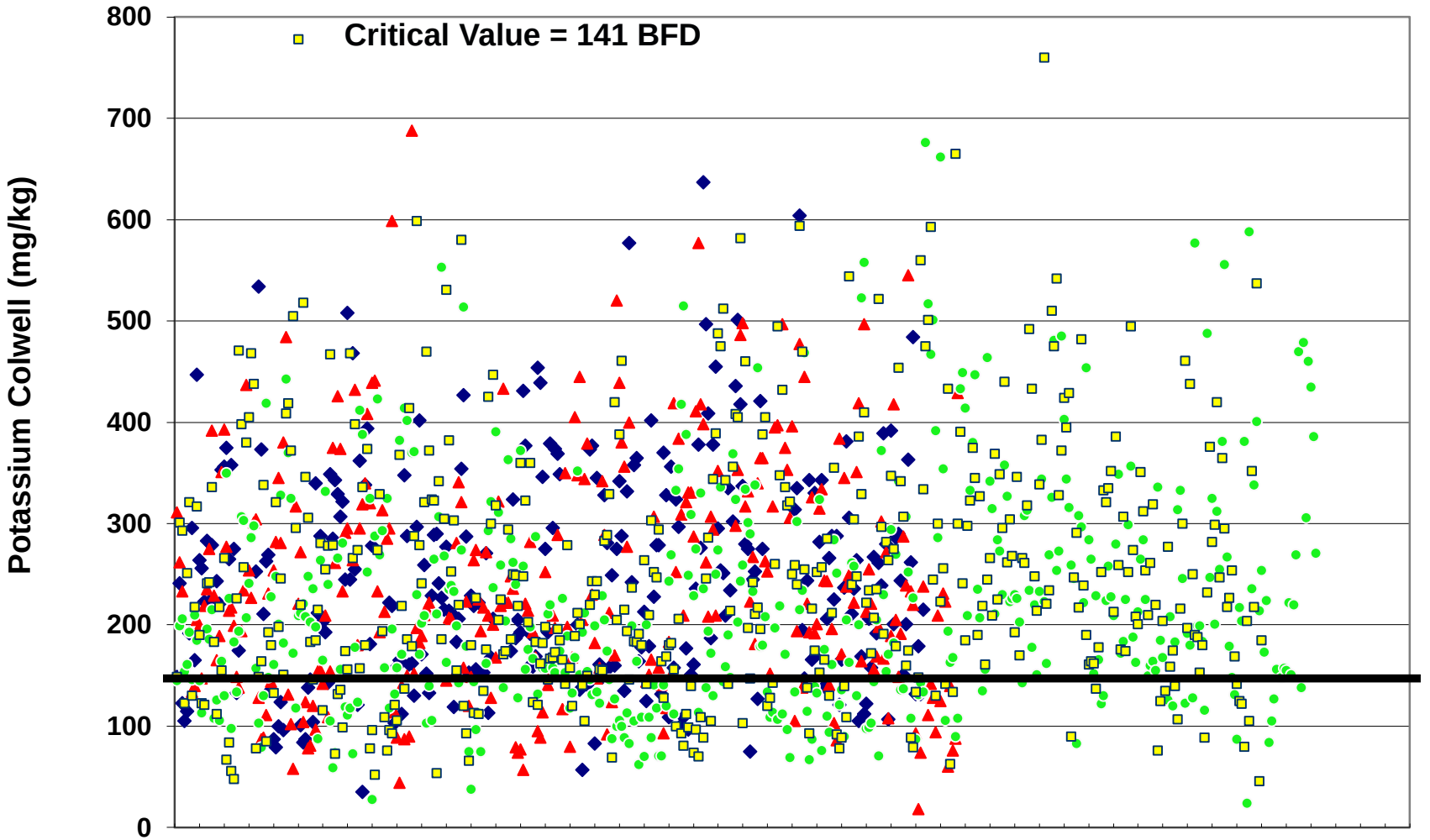
- Pastures @ 10DSE
- S exported off farm = 1kg S/Ha
- S moved to sheep camp = ~2kg S/Ha
- Need to replace ~3 kg S/Ha/year
- 125 kg/Ha Single = 13.8 kg S/Ha
- 400kg/Ha Gypsum = 60 kg S/Ha
- Maybe 1-2 kg s in rainfall from west
- Plan? Keep monitoring soil S

Holbrook Potassium



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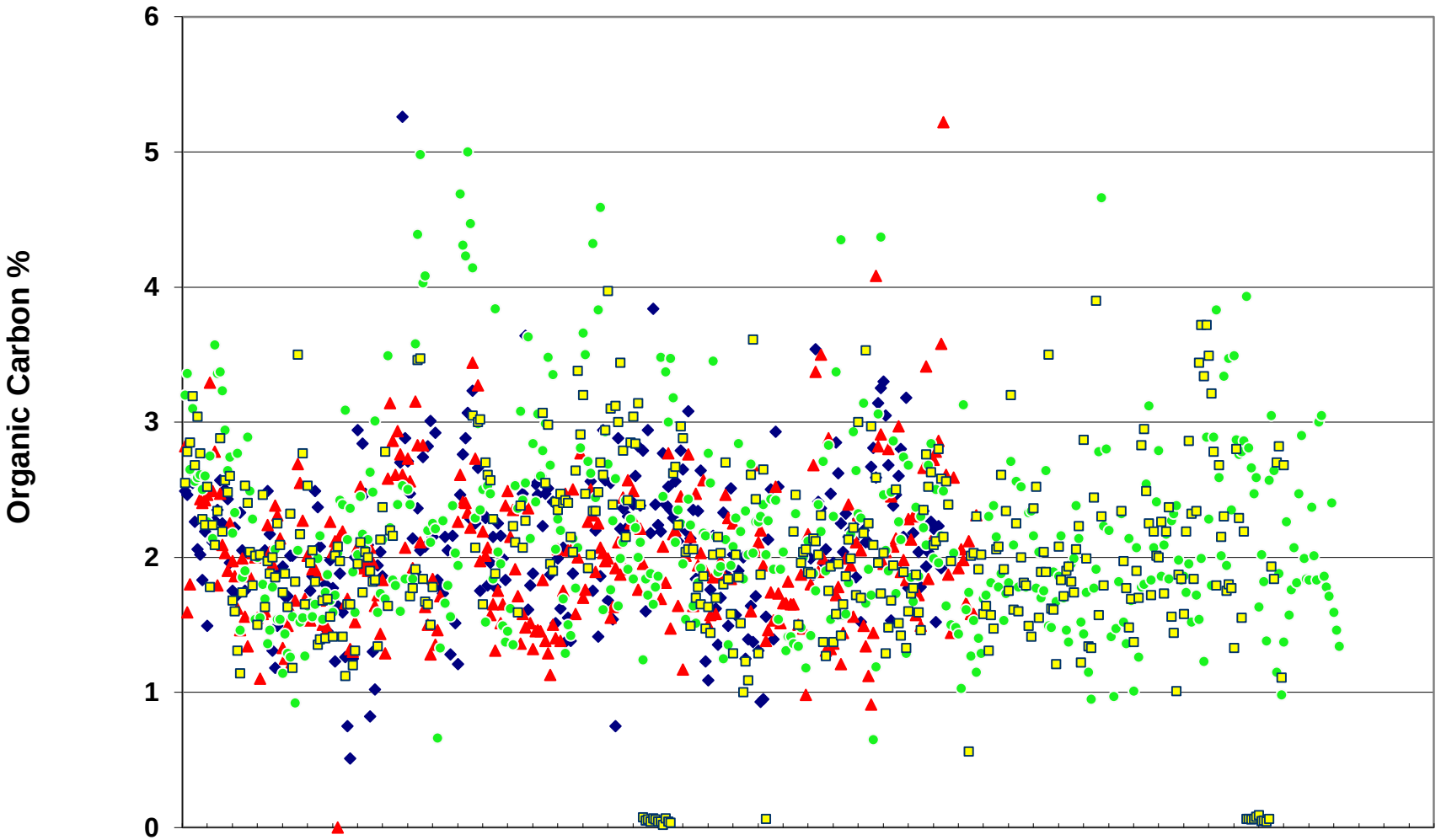
Holbrook Organic Carbon



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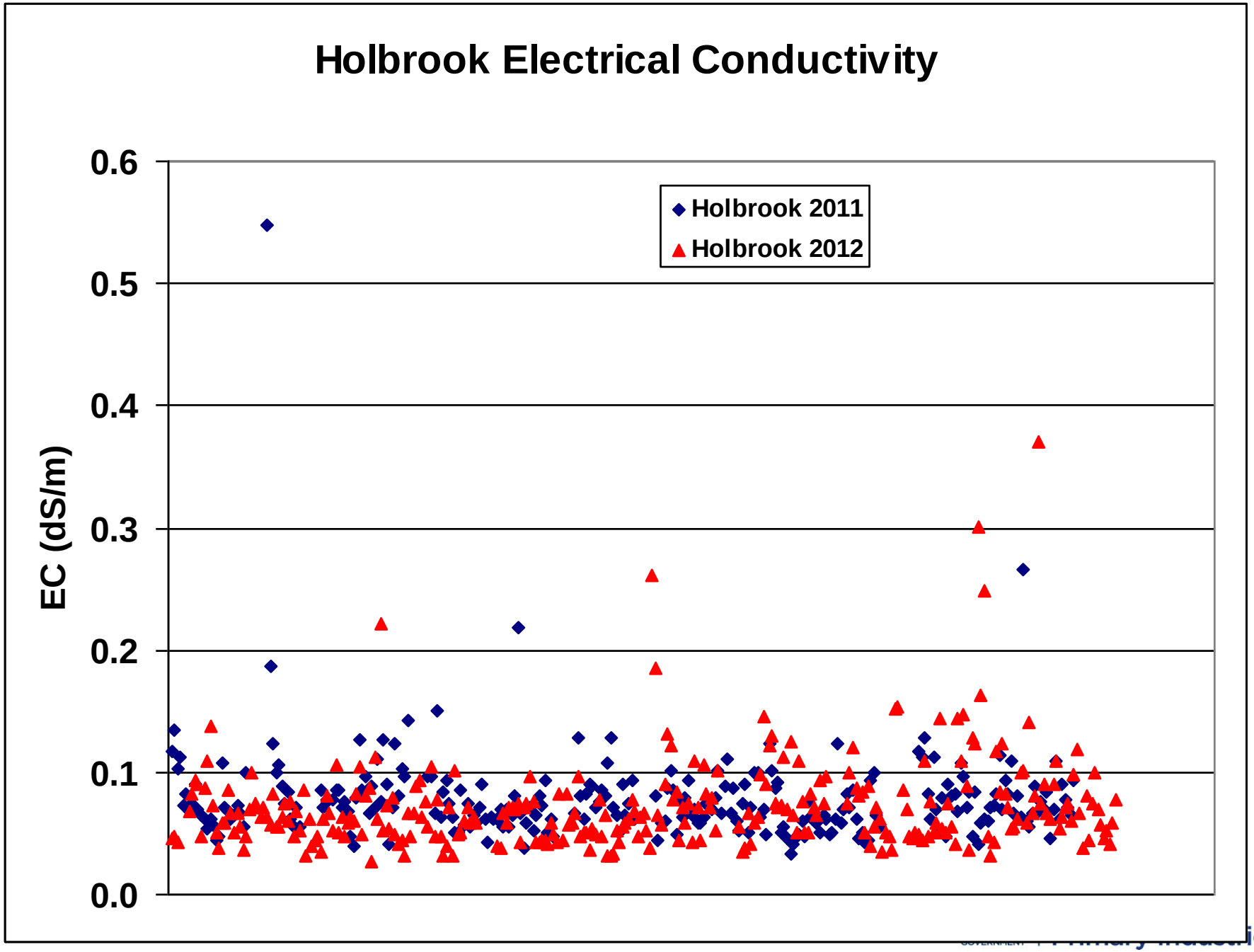
Holbrook Electrical Conductivity
EC (dS/m)
0.6
0.5
0.4
0.3
0.2
0.1
0.0
Holbrook 2011
Holbrook 2012

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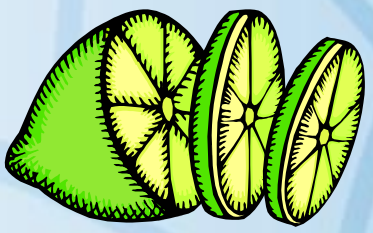
Soil Acidity and Liming



Why do soils become more acid?

- Climate is major influence on rate
- Higher rainfall =
    - higher leaching,
    - higher production and potential DSE and removal rates
    - higher OM cycling

  = increased acidification
- Some soils naturally acid.

Some effects of Acidity

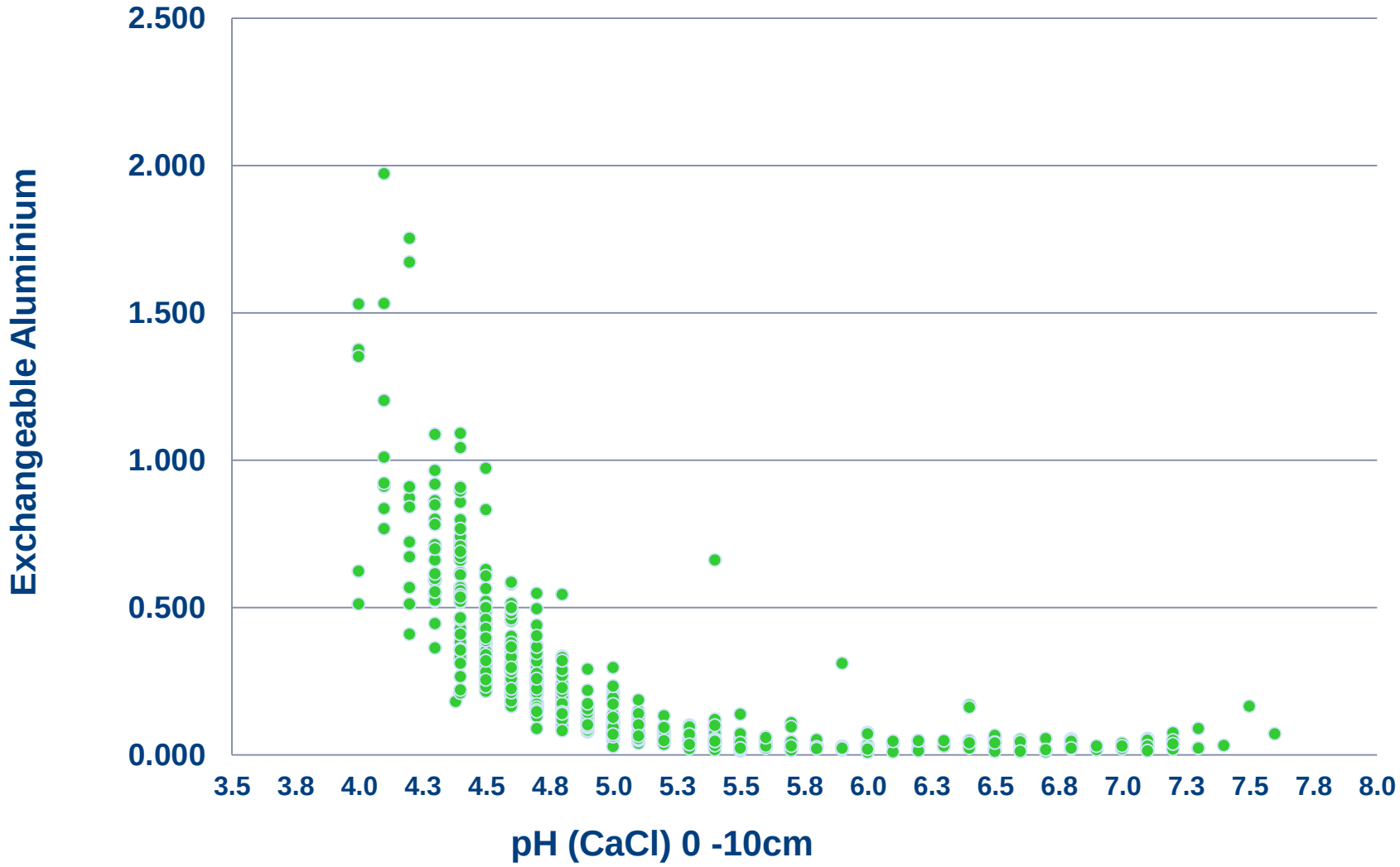
- Affects the availability of other nutrients
- Releases aluminium into solution (toxic to plants)
- Can impact on important components of soil biology (e.g. rhizobium)

Plant Tolerance

Al% sufficient to cause a 10% production loss by various pasture plants

Highly sensitive (5% Al)	Lucerne & most medics, buffel & tall wheat grass.
Sensitive (10% Al)	Phalaris seedlings, red grass, some danthonias.
Tolerant (15% Al)	Tall fescue, Rhodes grass, ryegrasses, mature phalaris, white clover & subterranean clover.
Highly tolerant (20% Al)	Cocksfoot, serradella, Consol lovegrass, paspalum, kikuyu, microlaena, some danthonias, Themeda, Maku lotus, couch & grazing oats.

Holbrook



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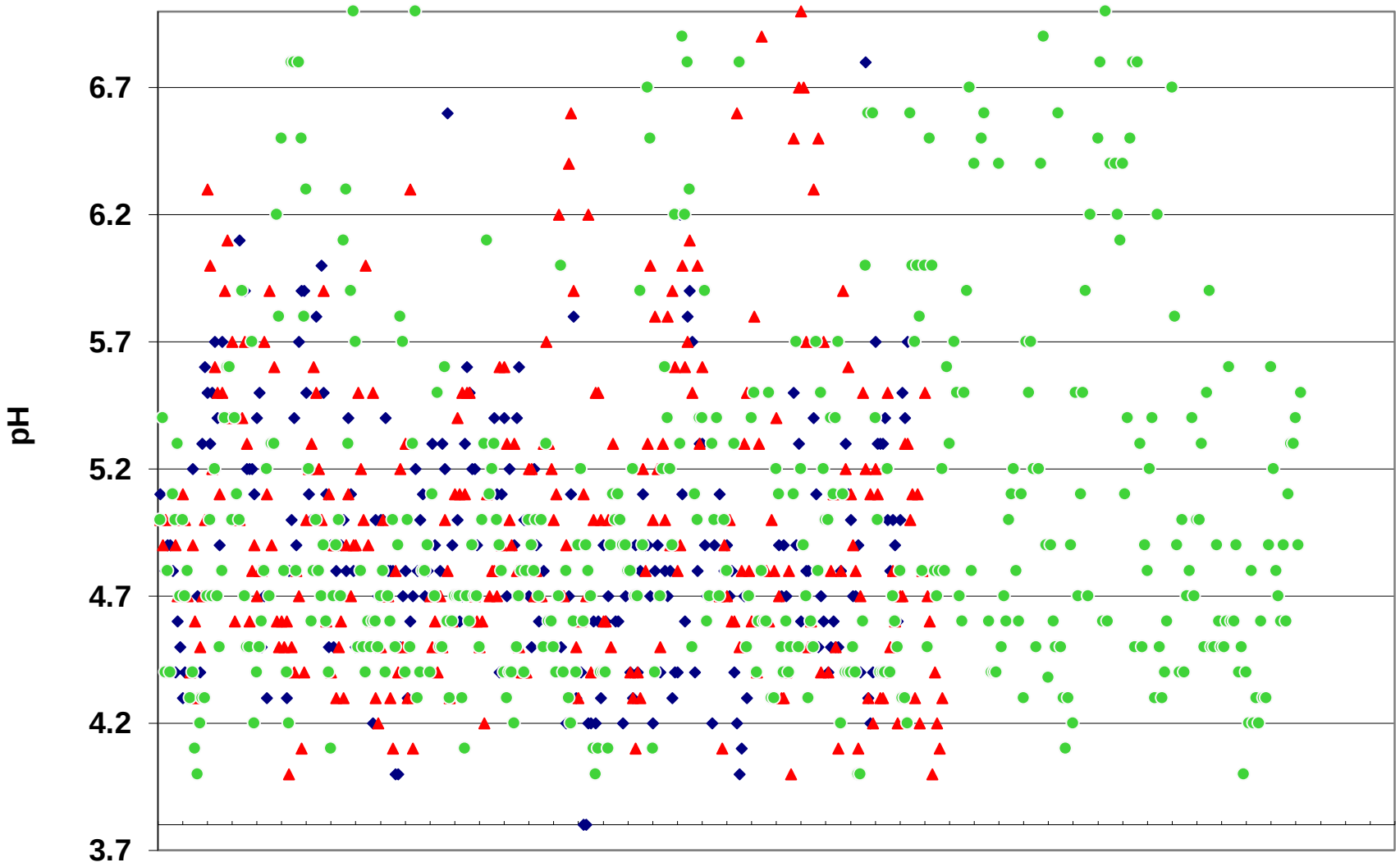
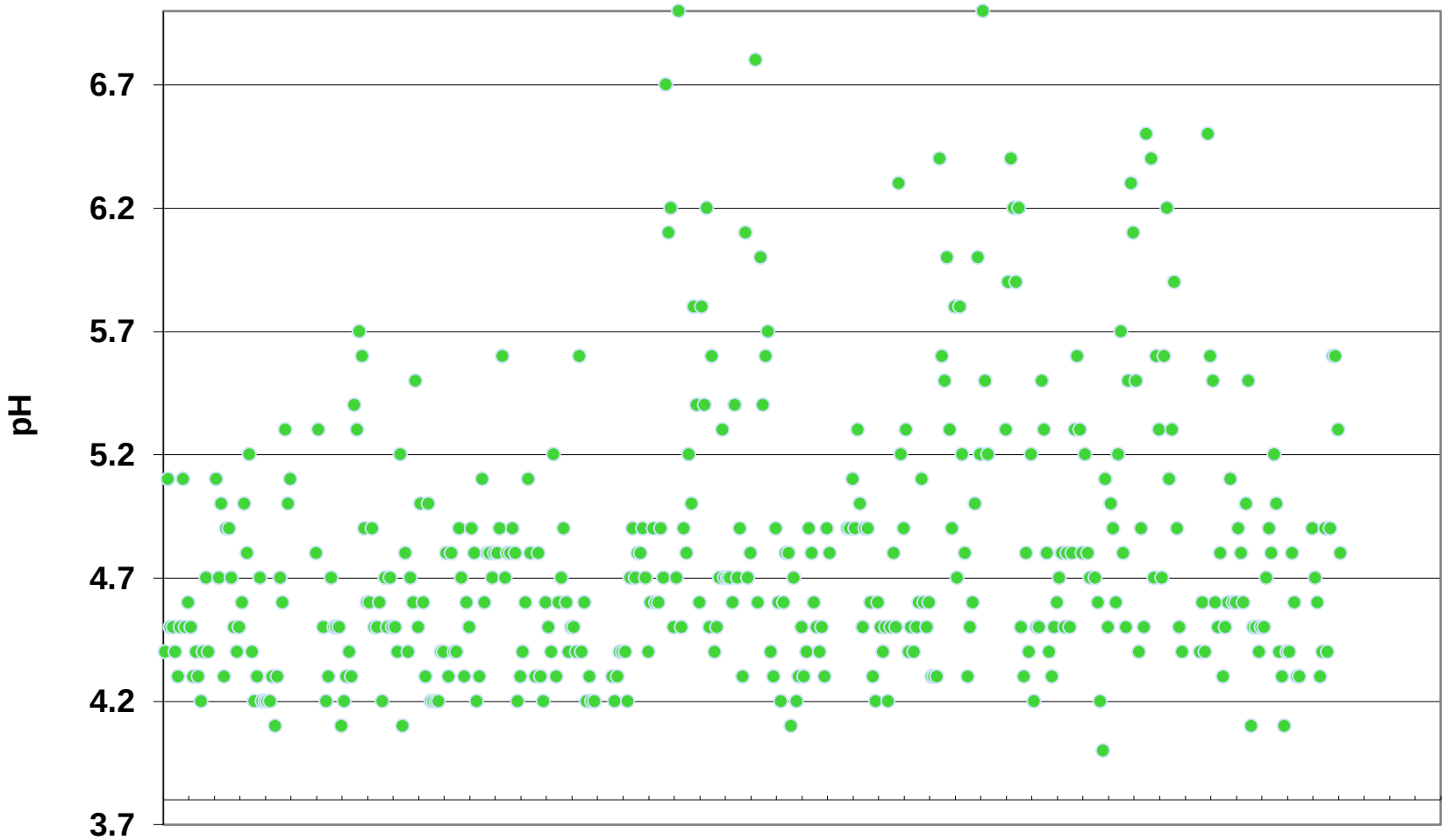
Holbrook $pH_{(CaCl2)}$ at 0 - 10cm



Holbrook $pH_{(CaCl2)}$ at10 - 20cm



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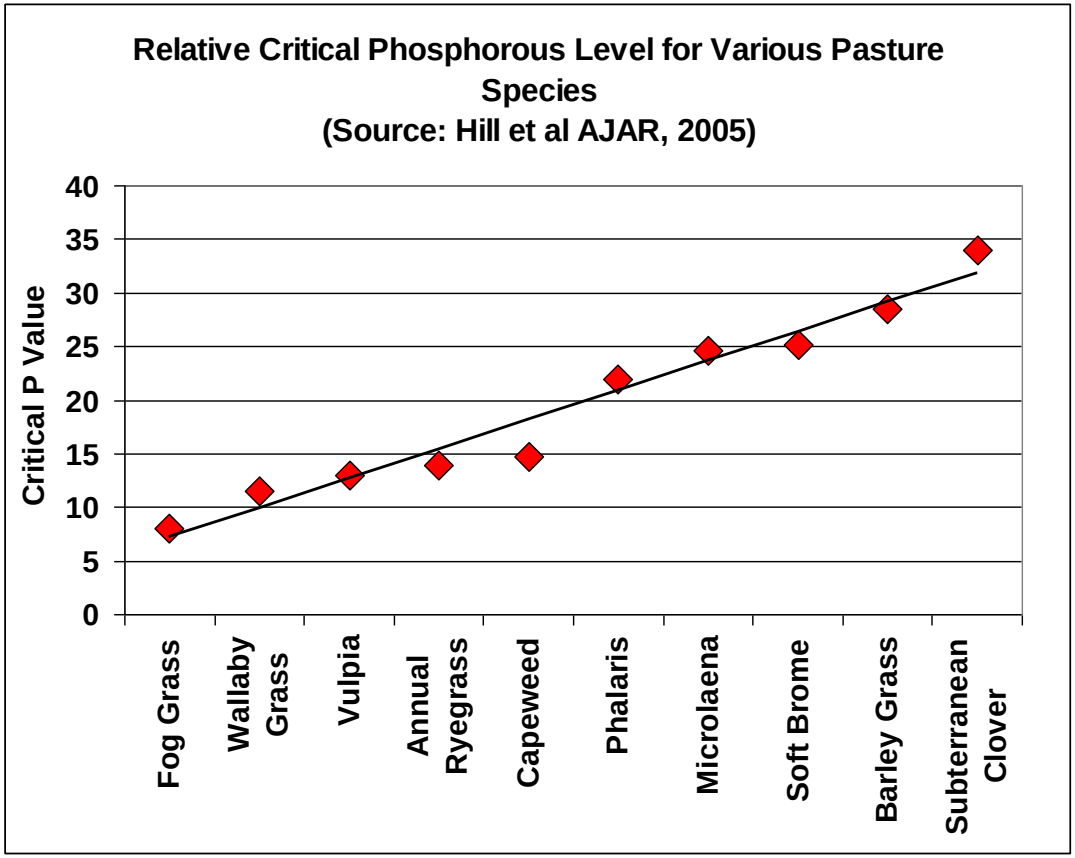
Phosphorous

The importance of Phosphorus

- Most Australian soils are naturally deficient in phosphorus
- The required level of phosphorus nutrition is driven by the needs of the legume.
- Legumes provide Nitrogen which drives grass production



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Critical Colwell Phosphorus for Pastures

PBI Category	Critical value[1] for mid point of PBI category Colwell value (Range)
< 15	23 (20 - 15)
15 - 35	26 (25 - 28)
36 - 70	30 (28 - 31)
71 - 140	34 (31 - 37)
141 - 280	41 (37 - 44)
281 - 840	56 (45 - 65)
> 840	n/a

Source: Better Fertilizer Decisions Project (2007)

1= Critical Colwell P value at mid-point of PBI class. Values in parenthesis are critical Colwell P values at the lowest and highest PBI values within the range.
n/a = insufficient data to derive response relationship.

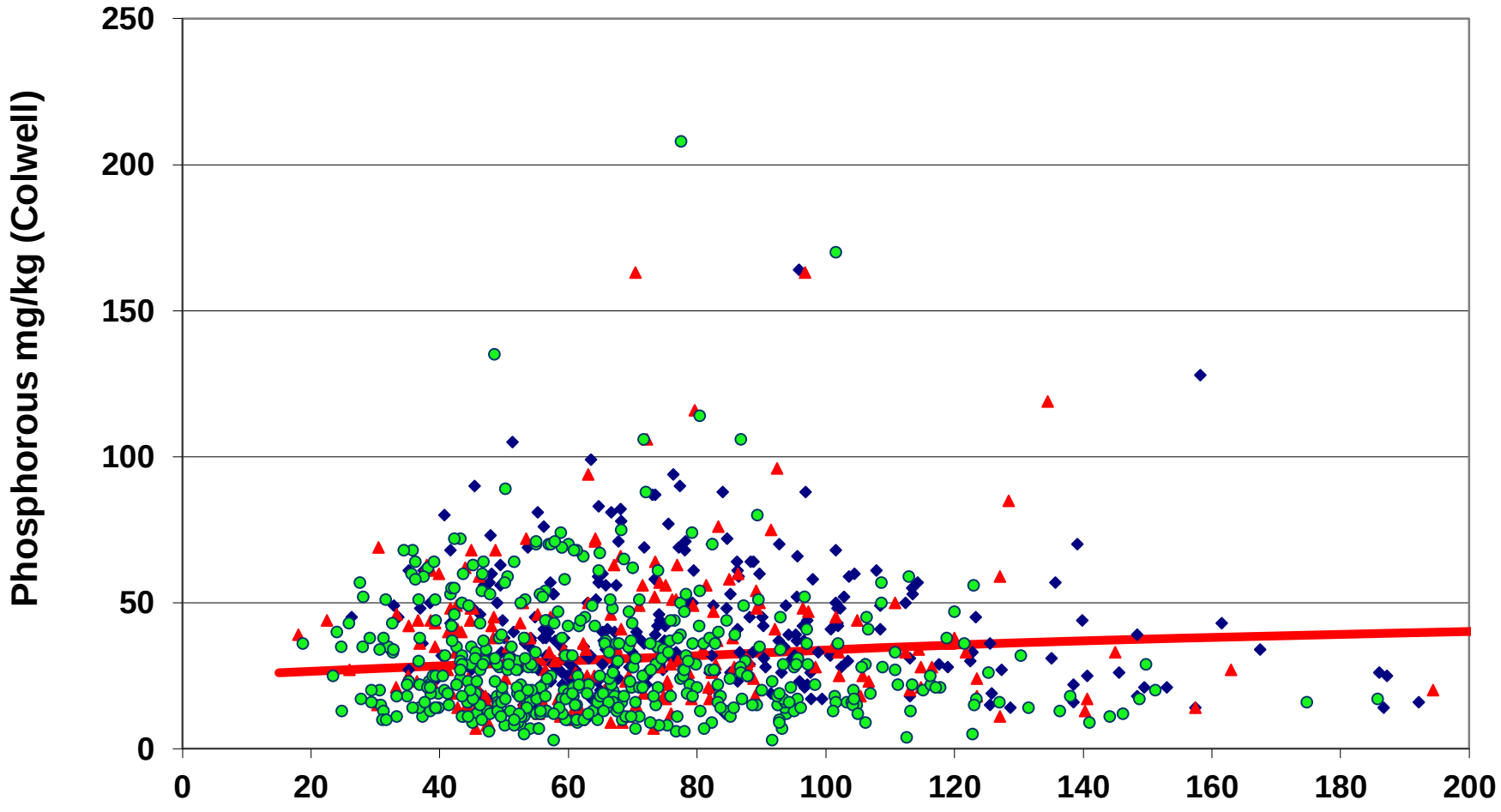
Colwell-P criteria – South

Crop	Soil type	Critical values (mg/kg)	Critical range (mg/kg)
Wheat and barley	Vertosols	17	12-25
	Chromosols/sodosol	22	17-28
	Brown/red chromosol	25	18-35
	Calcarosol	34	26-44
Barley	Ferrosol	76	46-130
Canola	All Soils	18	16-19
Field pea	All Soils	24	21-28

- 0-10 cm depth and 90% RY
- Currently insufficient data to provide similar calibration criteria for DGT-P

Source: Better Fertiliser for Crops 2013

Holbrook Phosphorous vs PBI



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Holbrook Landcare Network

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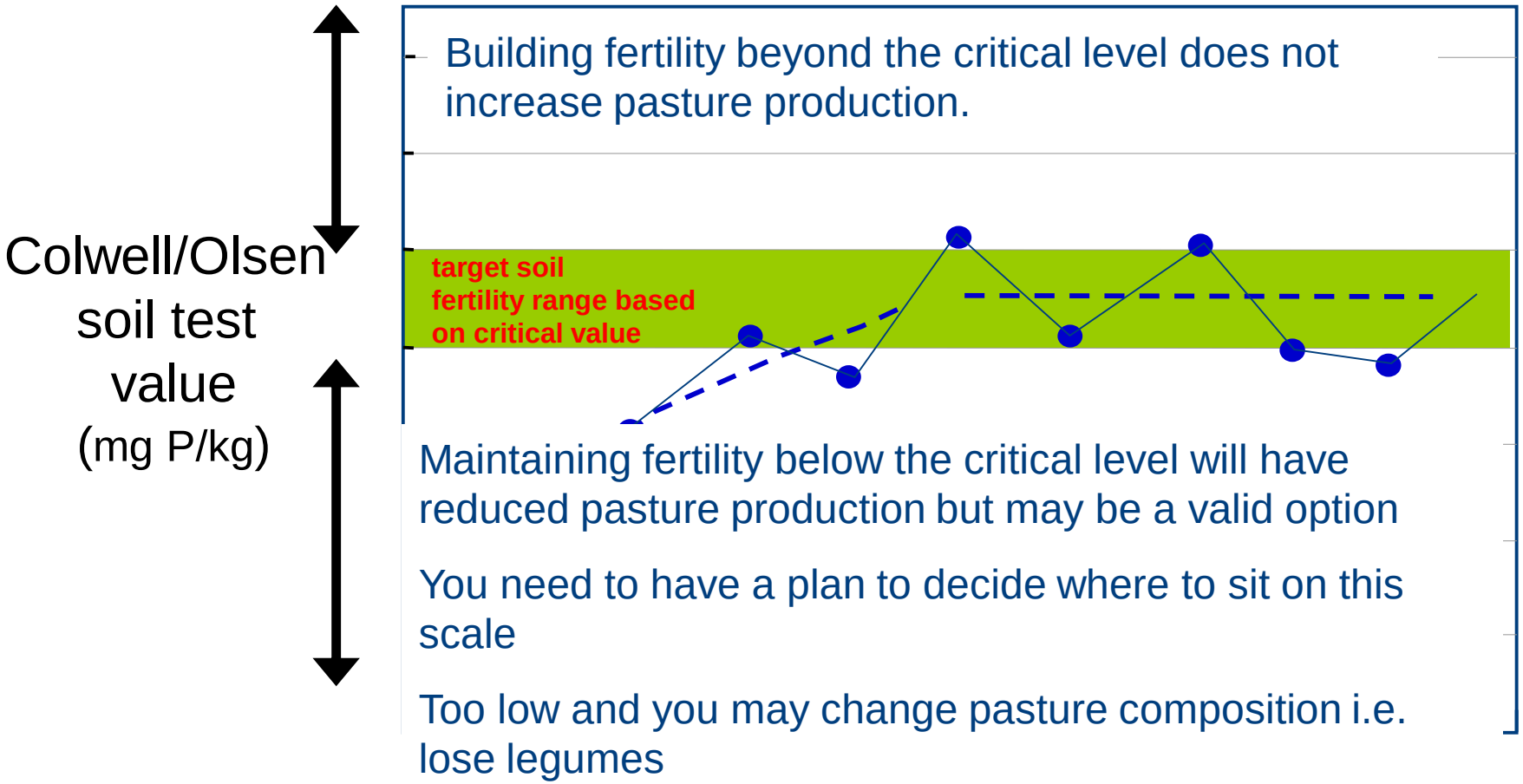
What level should I target?

- Your target soil fertility will depend on a number of factors including:
    - Which soil test?
    - Where are you at now?
    - Your production goals.
    - Financial evaluation

- Your starting point is to understand the “Critical Soil Level” for optimum pasture production.

“Managing the Trend”



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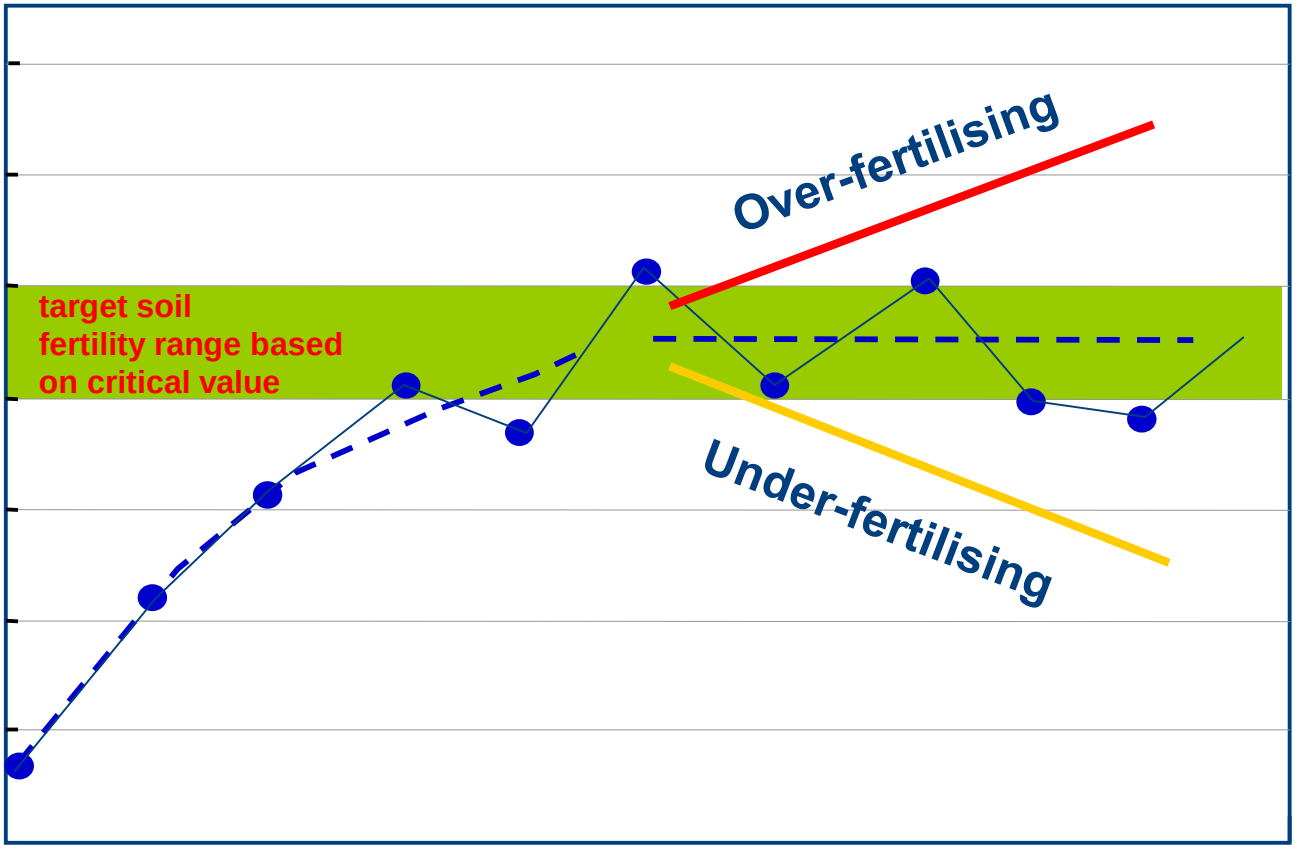
“Managing the Trend”

Colwell/Olsen soil test value (mg P/kg)



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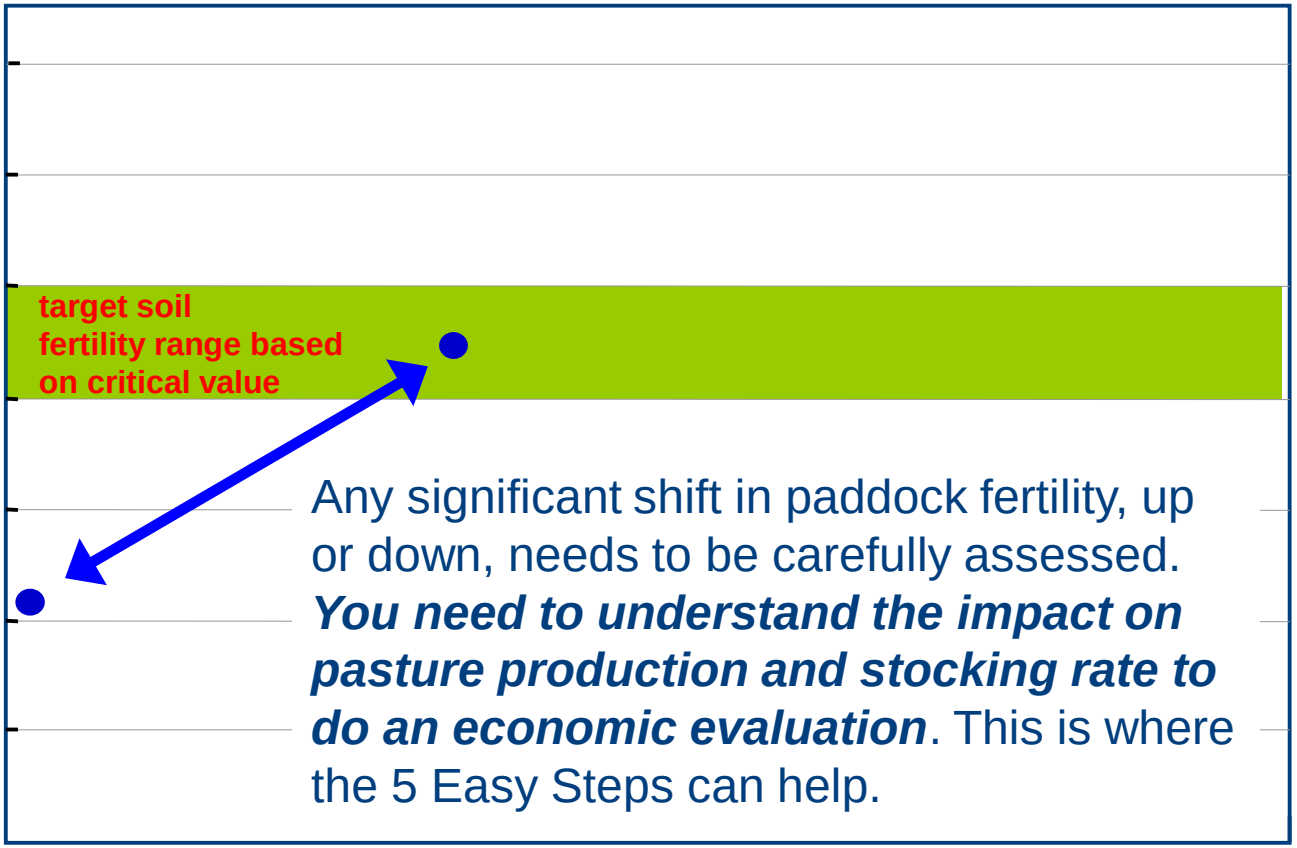
Plan carefully any changes to paddock fertility

Colwell/Olsen soil test value (mg P/kg)



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How much P to apply

- P Application = P Removal + P Losses + Capital P
- P removal is calculated from stocking rate with allowances for factors such as erosion and sheep camp effects.
- The trend over time will help you refine this figure for your property and grazing management.

Appendix 1: DSE ratings for various classes of livestock.

Table 1. DSE ratings of livestock during the year.

Annual DSE ratings for livestock are required for estimating stocking rates and carrying capacity in the 5 Easy Steps worksheet and computer tool.

The figures immediately below are not necessarily the annual ratings that you will need but are supplied to help you calculate annual DSE ratings.

These DSE ratings are for the animal while it is in the listed category: e.g. for a 500 kg cow. While she is lactating the rating is 15.2 (cow and calf) but the cow might only lactate for 6 months. The categories that apply in the other 6 months of the year are a combination of late pregnant and dry.

'Pregnant' in sheep applies to the last month of pregnancy and in cattle to the last 3 months.

Some examples of whole-of-year enterprise ratings are on the next page (Table 2).

Mature wethers:
Scaling for wethers of different liveweights is the same as for dry, mature ewes.

Mature ewes					
Liveweight (kg)	Dry	Pregnant		Lactating	
		single	twin	single	twin
40	0.9	1.1	1.3	2.1	2.9
50	1.0	1.3	1.5	2.5	3.4
60	1.2	1.4	1.6	2.9	4.1

Growing lambs				
Liveweight (kg)	Growth rate (g/day)			
	50	100	150	200
20	0.6	0.8	1.0	1.2
30	0.9	1.1	1.3	1.5
40	1.0	1.3	1.5	1.65

Breeding cattle			
Liveweight (kg)	Dry	Pregnant	Lactating
350	6.0	7.0	12.3
400	6.5	7.7	13.7
450	6.9	8.2	14.8
500	7.1	8.4	15.2
550	7.7	9.0	16.5
600	8.4	9.7	17.3

Growing cattle			
Liveweight (kg)	Growth rate (kg/day)		
	0.5	1.0	1.5
200	5.3	6.8	8.3
250	6.4	8.1	9.7
300	7.3	9.2	11.1
350	8.4	10.6	12.9
400	9.1	11.4	13.7

Table 2. Examples of annual DSE ratings for whole enterprises.

For breeding enterprises, these ratings include the female, progeny and replacement females over a 12-month period.

Ewes

50 kg Merino ewe (fleece free and no gut fill)

Marking percentage	All progeny kept for 12 months	Wethers sold @ 5 months, ewe kept
105	2.3	2.1
95	2.2	2
85	2.1	1.93
75	2	1.86

70 kg first cross ewe (fleece free and no gut fill)

Marking percentage	All lambs sold at 8 months	All lambs sold at 12 months
125	2.73	2.96
115	2.62	2.86
105	2.54	2.76
95	2.46	2.66

Cows

500 kg cow for 12 months and calf for 6 months	11.4 dse
500 kg cow and calf for 12 months	15.0 dse
Trading steers in paddock for 12 months	9.0 dse
Trading steers in paddock for 6 months	4.5 dse

Examples

Example 1: 1500 Merino ewes (50 kg liveweight) with 95% marking percentage.

1500 * 2.2 = 3300 DSE, which includes the ewes, lambs for 12 months and replacement hoggets.

If all these sheep were run on 450 ha, then the stocking rate is: 3300/450 = 8.25 DSE/ha

Example 2: Paddock running wethers for 6 months and traded lambs for 4 months.

Trading 800 lambs gained 20kg whilst grazing the 50 ha pasture paddock for 4 months.

Use the figures from Table 1: 30 kg is nearest to the average of the trade (in at 25 kg; out at 45 kg) and the average growth rate is about 180 g/head/day (estimate between the 150 and 200 g/head/day figures).

800 lambs *1.4 * 0.33 (only on the property for 4 months out of 12) = 370 DSE.

The stocking rate during the 4-month period is: 370/50 = 7.4 DSE/ha.

The paddock was spelled for 2 months (0 DSE) and then ran 200 wethers (55 kg liveweight) for 6 months: 200 wethers * 1.1 * 0.5 = 110 DSE.

The annual figure is: (370+110) = 480 DSE

And the annual stocking rate was: 489/50= 9.4 DSE/ha

How do you know it is going to pay?

- If investing in fertiliser you need to capture the expense through increased stocking rate or crop yield
- The 5 Easy Steps provides a process to estimate pasture response and animal enterprise response to a planned change in soil fertility.
- Maximum production is not always the most profitable (or the most relaxing!).

Tools to help

- Five Easy Steps booklet and tool available for download from: www.mla.com.au/nutrients
- Paddock DSE Tool –
  - nigel.phillips@dpi.nsw.gov.au
- Seek advice from reputable experienced agronomist

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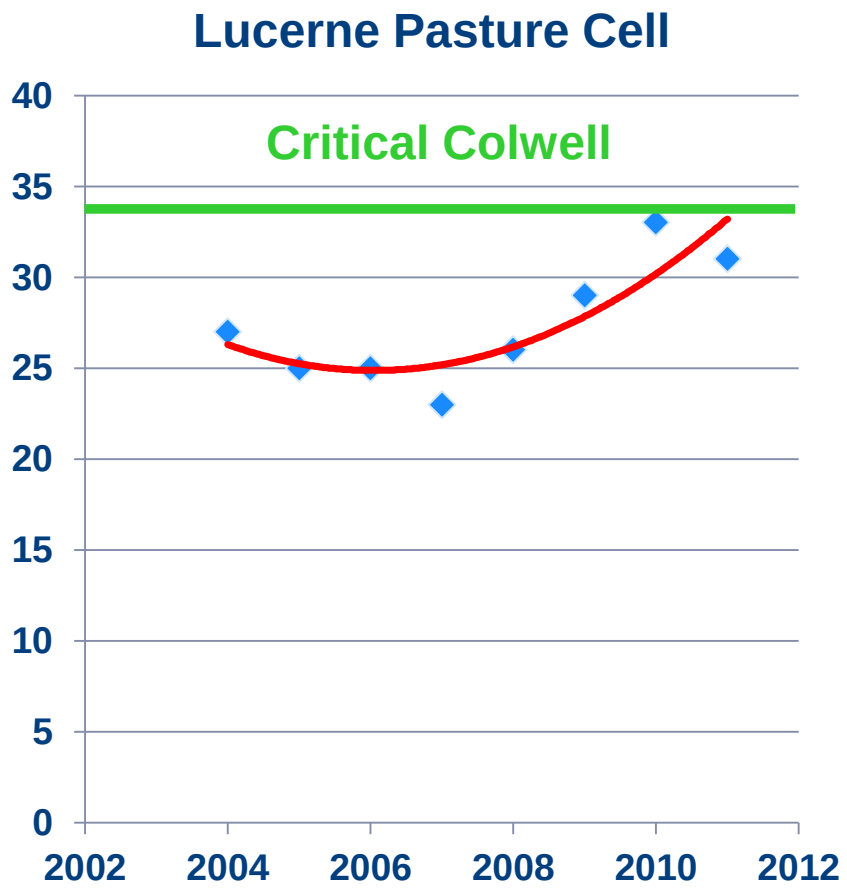
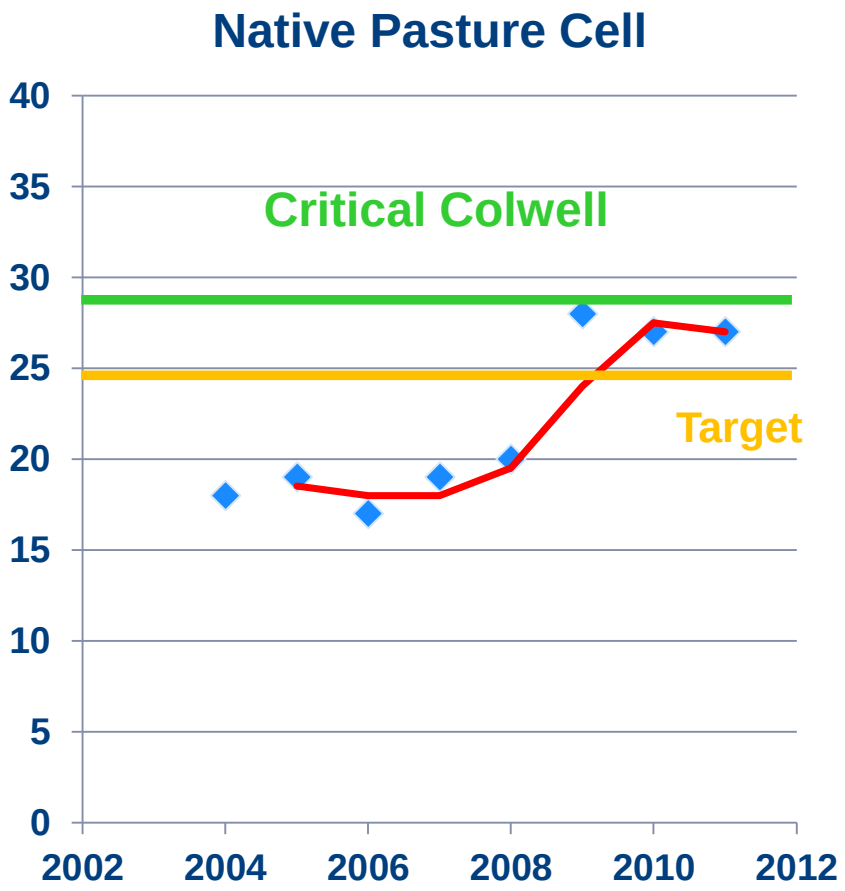
Some real paddocks





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