Liming pastures – the soil-plant-producer continuum

Jason Condon – Charles Sturt University

Richard Hayes – NSW Department of Primary Industries and Regional Development

John Jervois – Jervois Pastoral

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Liming pastures – the soil-plant-producer continuum

Charles Sturt University

Soil

A/Prof Jason Condon
Charles Sturt University

Plant

Dr Richard Hayes
NSW DPIRD

Producer

John Jervois
Jervois Pastoral

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Liming pastures – the soil-plant-producer continuum

The Soil

A/Prof Jason Condon

Charles Sturt University

Charles Sturt University

NSW GOVERNMENT Department of Primary Industries

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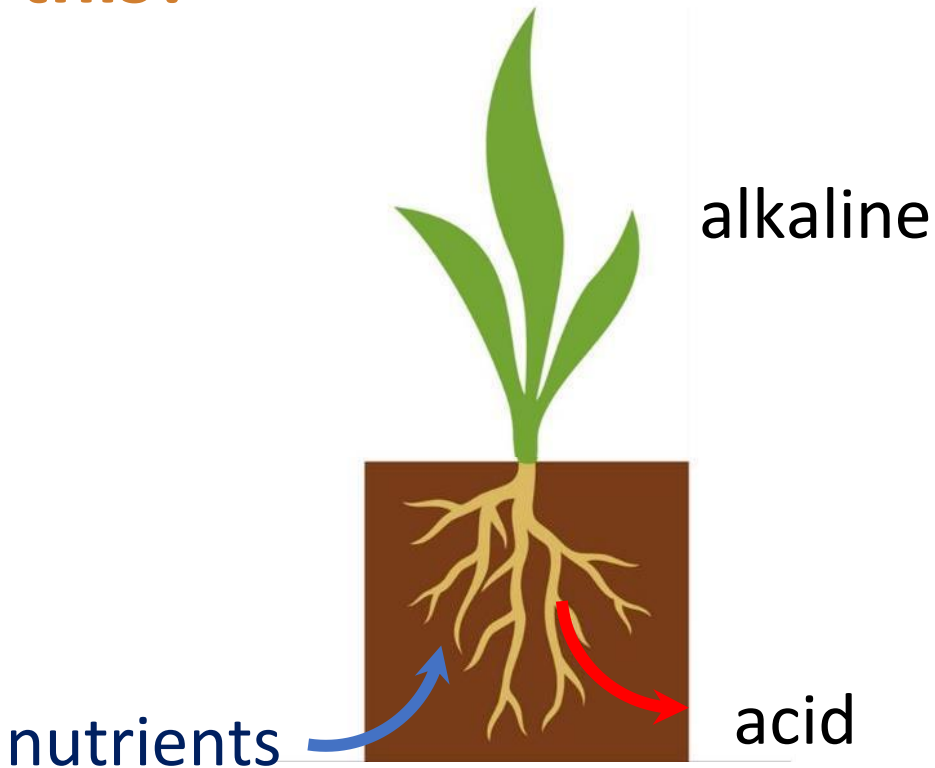
How did we get to this?



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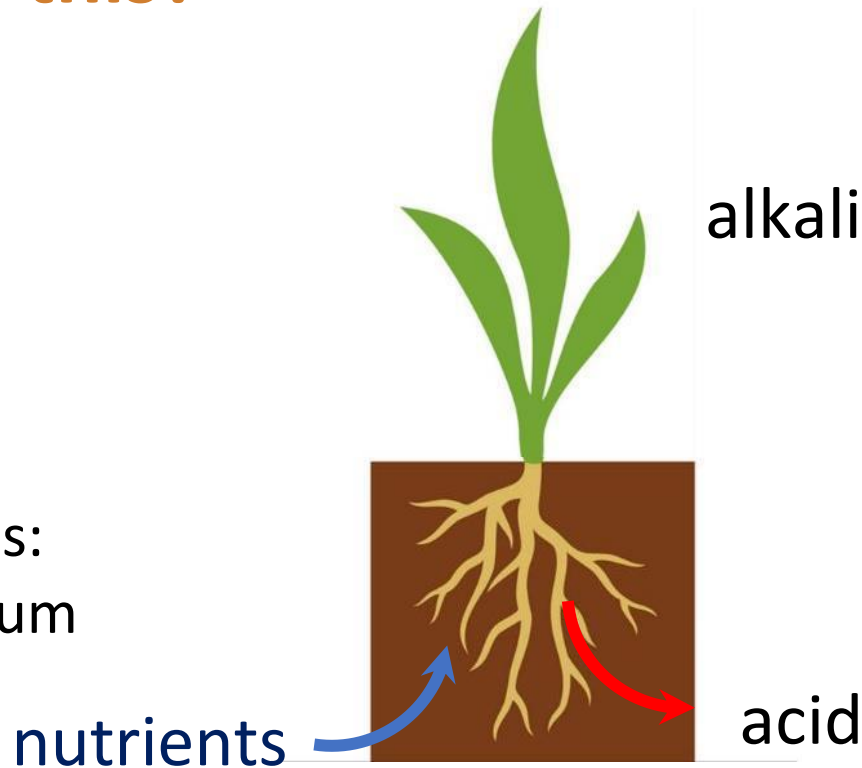
How did we get to this?

Grain
Hay
Meat
Wool

Nitrogen inputs:
Urea, ammonium
Legumes



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We are all on the same track

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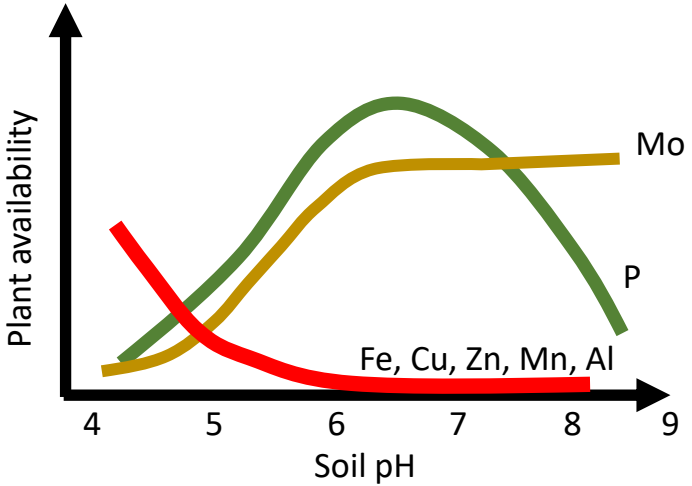
What happens at the destination Acidity?

Affects plant growth

Nutrient availability



Source: agric.wa.gov.au

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What happens at the destination Acidity?

Affects plant growth

Nutrient availability

Root growth decreased

Nodulation decreases

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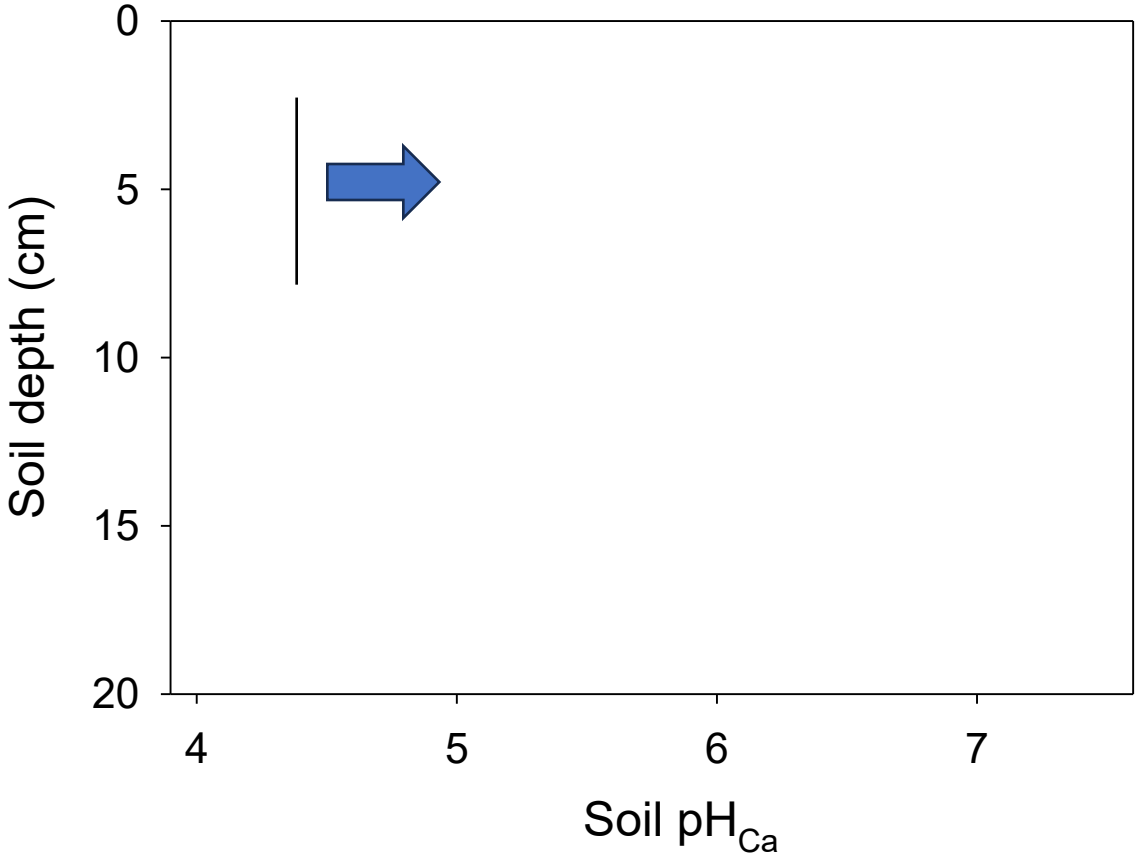
Do I have an acid soil?



0-10 cm

Apply lime

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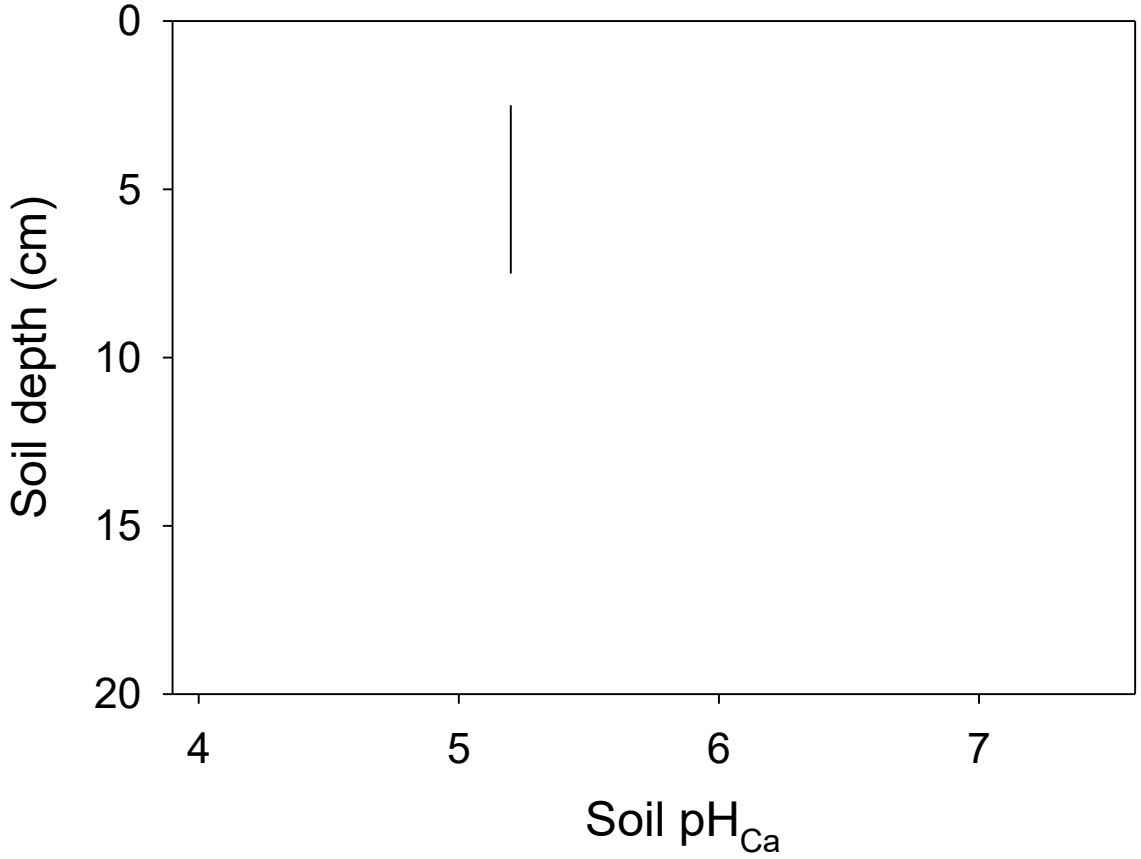
Do I have an acid soil? pH 5.2



0-10 cm

Lime worked

But did it?

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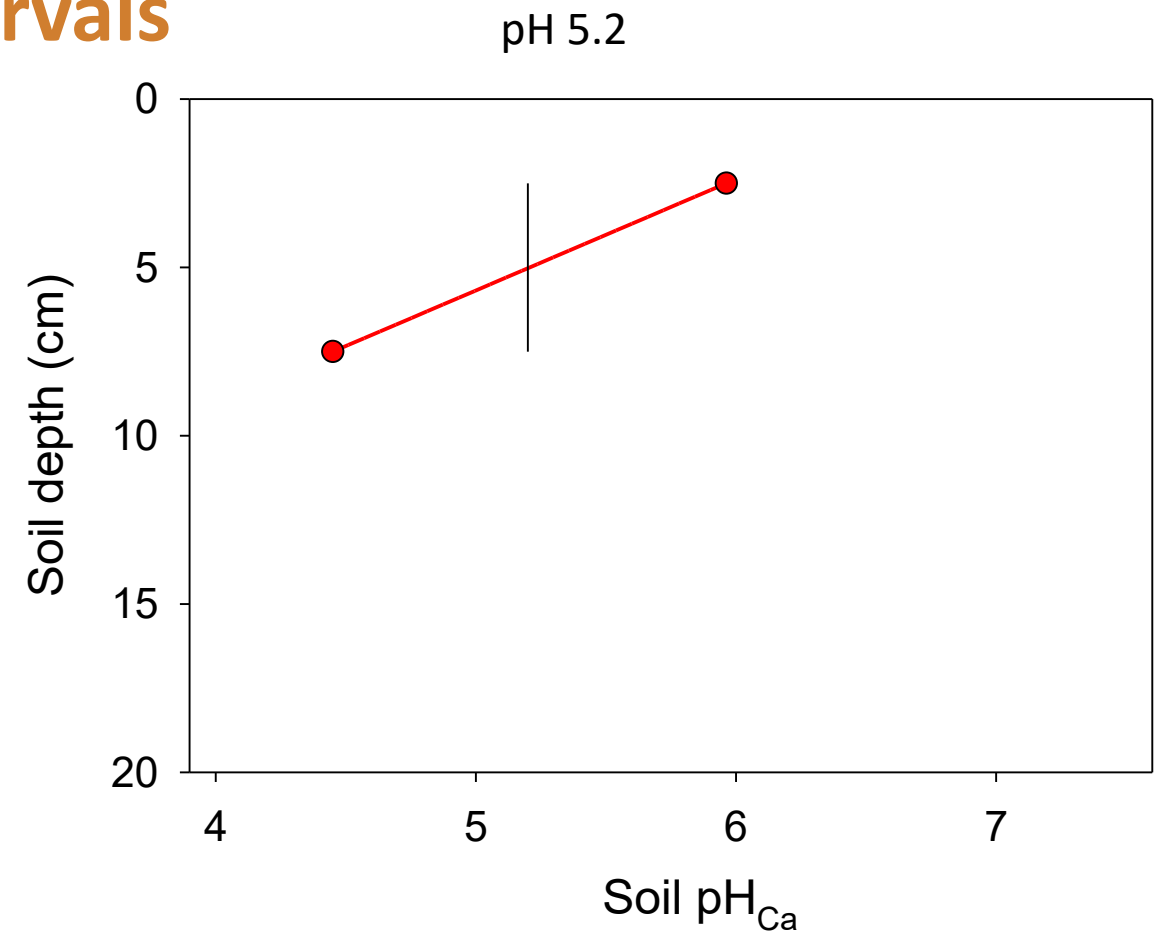
5 cm intervals



Lime = pH change at the surface only

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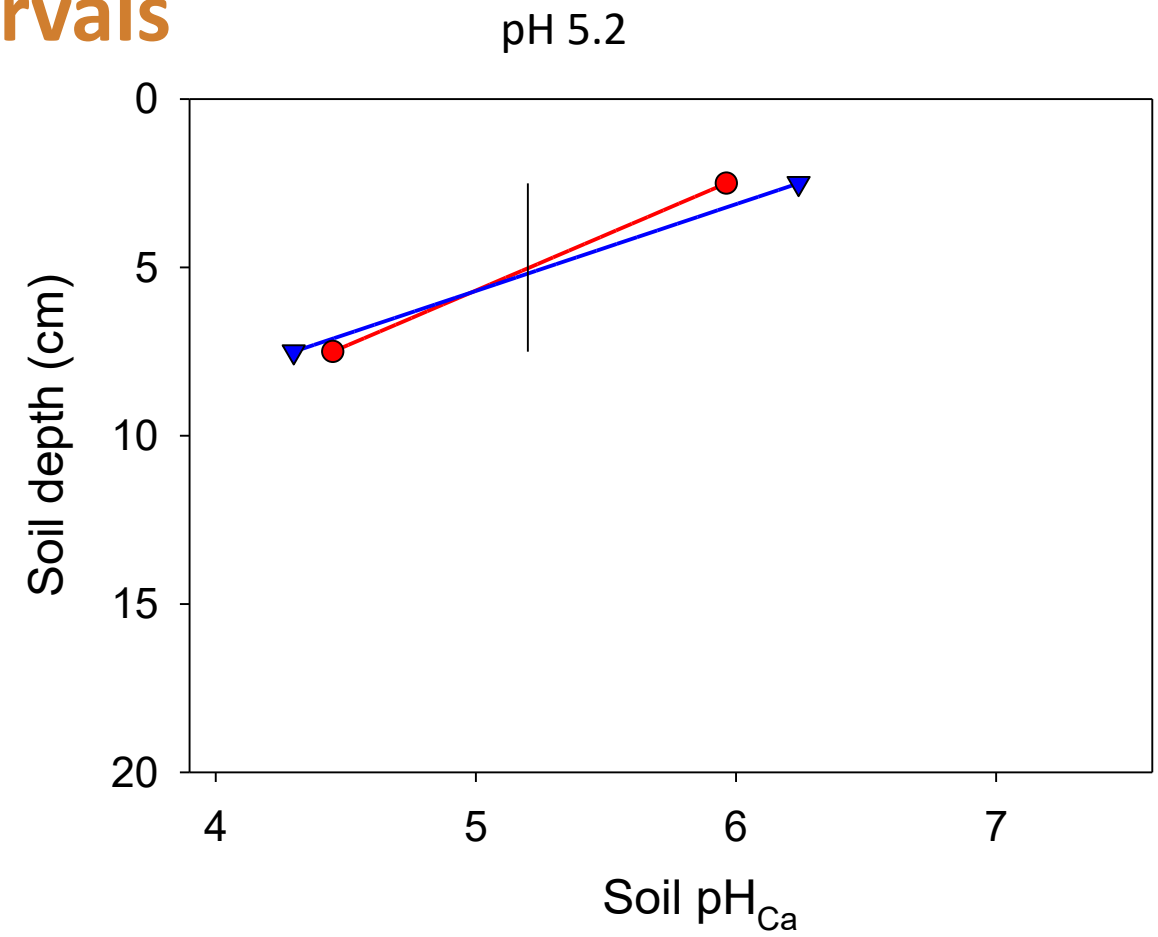
5 cm intervals



Many ways to get the same average

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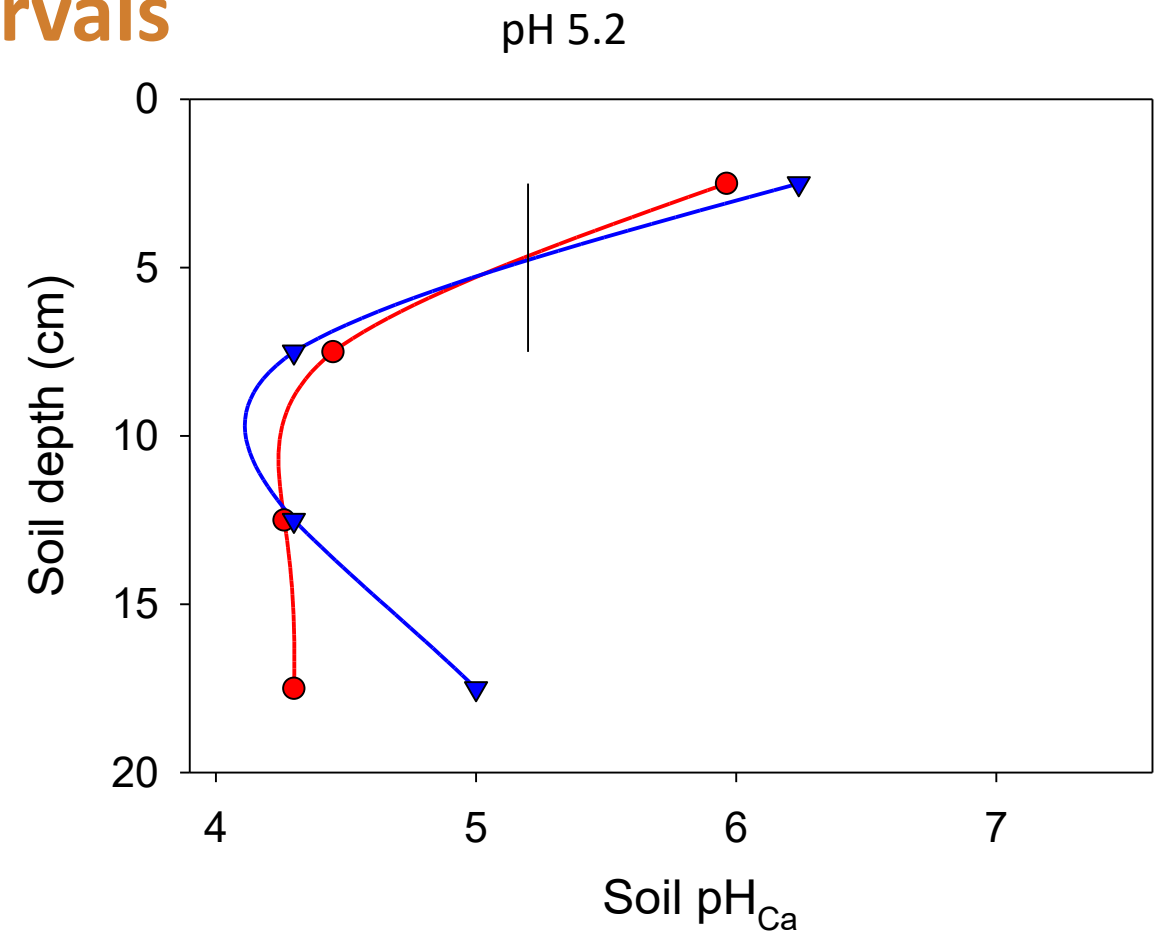
5 cm intervals



Different needs

Different outcomes

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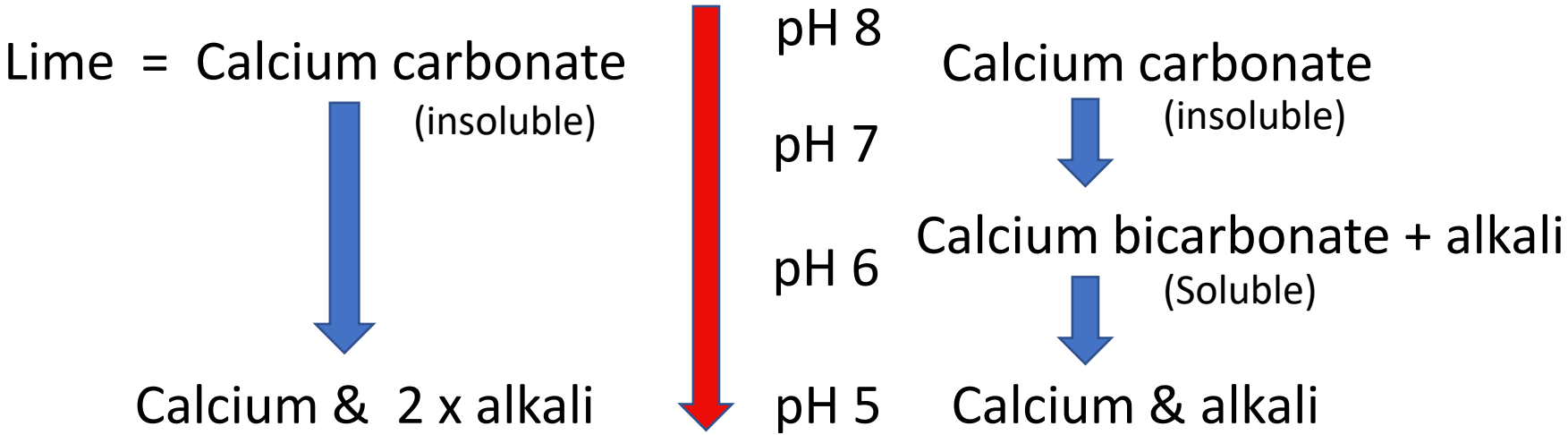
New pH targets

pH_{Ca} 6.0 if you want lime to move



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Take home messages

- We are all on the same tracks – destination acidity
- Testing in 5 cm intervals finds if you have acidity
- New target pH 6 IF you want lime effect to move

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Liming pastures – the soil-plant-producer continuum

The Plant

Richard Hayes

Research Agronomist

Charles Sturt University

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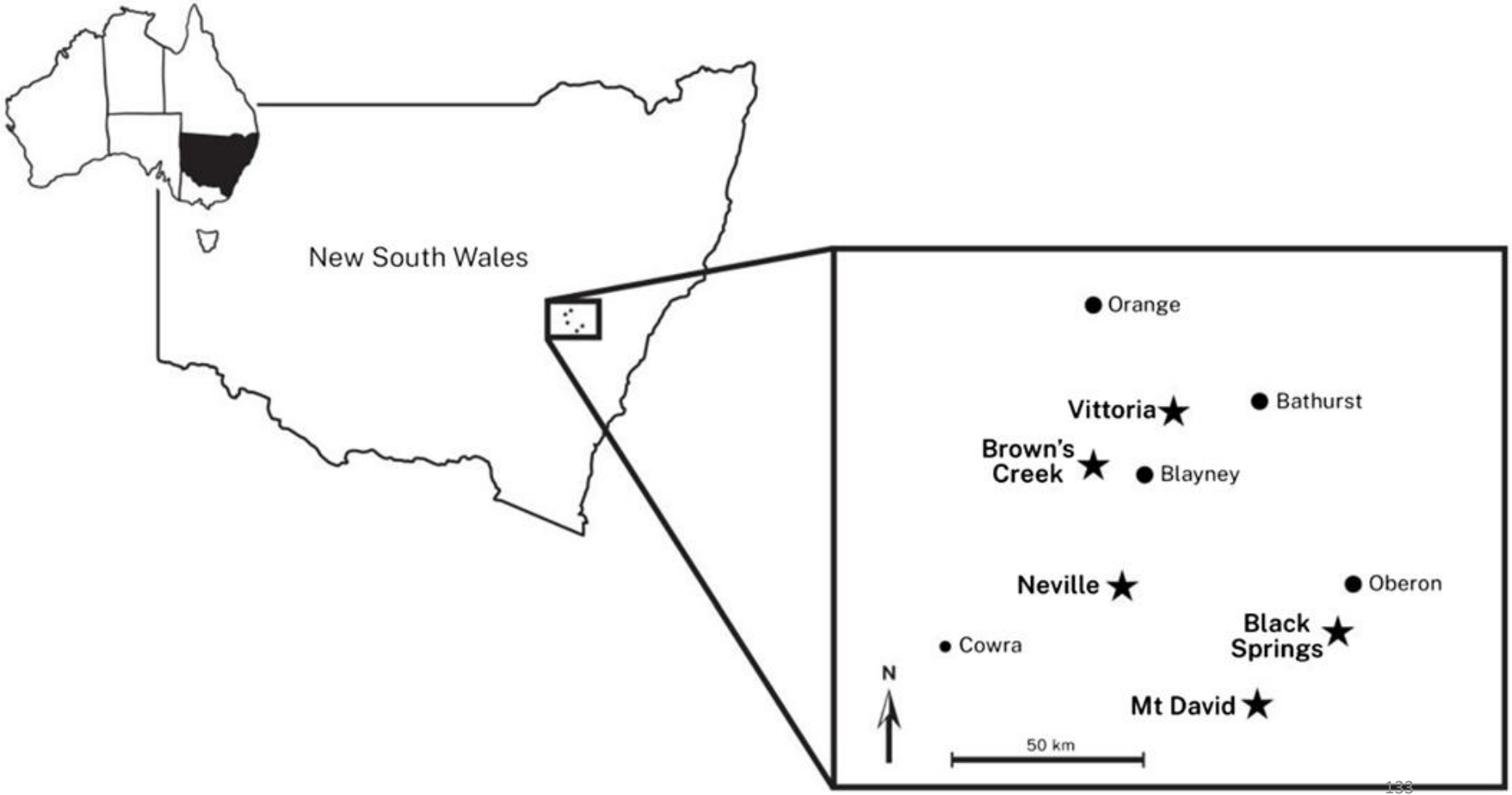
awi Australian Wool Innovation Limited

https://www.publish.csiro.au/CP/CP24336

- Dr Peter Dowling

Changes in pasture and soil properties with liming and superphosphate application on five soils in the Central Tablelands of New South Wales over 12 years

P. M. Dowling[A,B,F], I. A. Vimpany[C,D,F], M. K. Conyers[E,F], G. D. Millar[A], K. R. Helyar[E,F], D. L. Michalk[A,F], H. I. Nicol[A,F], J. Bradley[D,F], P. J. Milham[D,F,G] and R. C. Hayes[E,*]


New South Wales
Orange
Vittoria
Bathurst
Brown's Creek
Blayney
Neville
Oberon
Black Springs
Cowra
N
Mt David
50 km

Experimental design

5 sites

2 experiments (Acid sensitive/Acid tolerant spp.)

5 lime rates: 0, 0.63, 1.25, 2.5, 5.0 t/ha – applied once

3 superphosphate rates: 0, 125, 250 kg/ha – applied annually

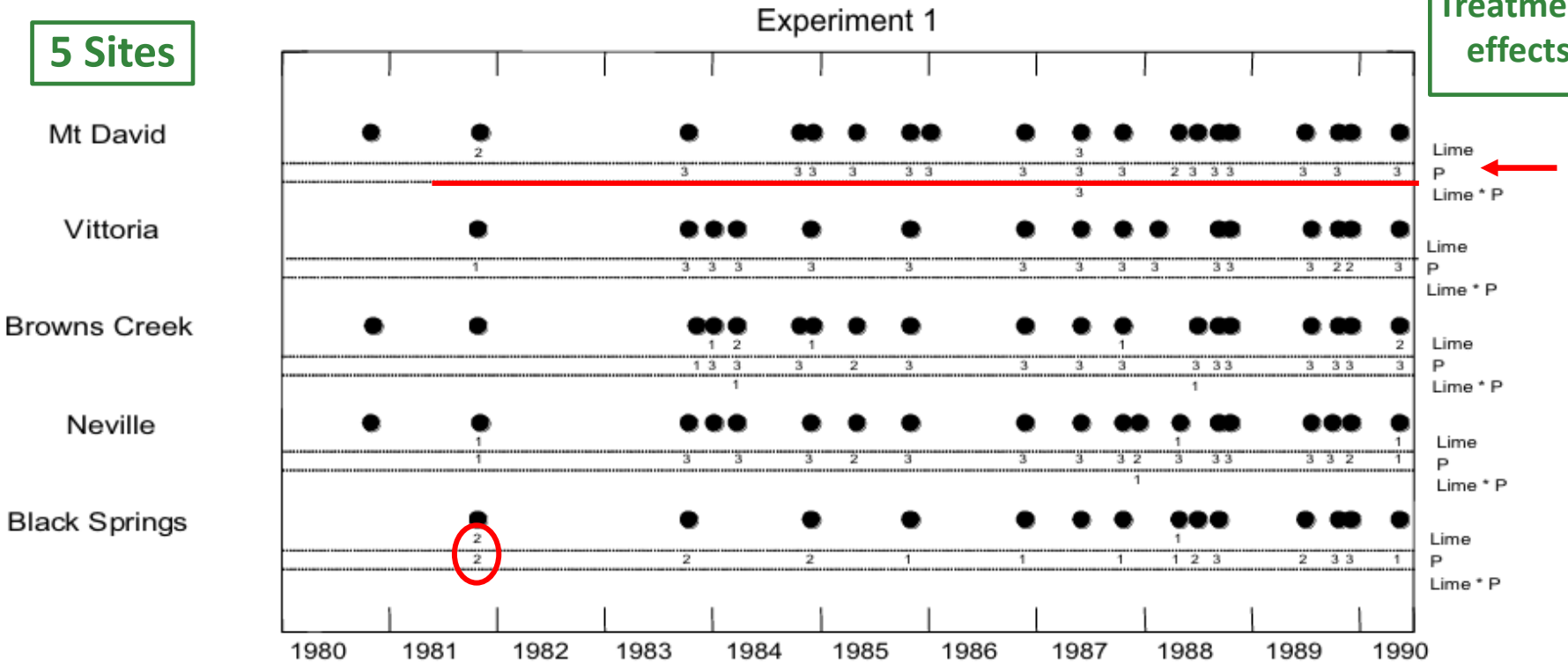
2 replicates

12 Years: 1979-1990

Plot size: 5 × 3 m

Biomass harvests

5 Sites

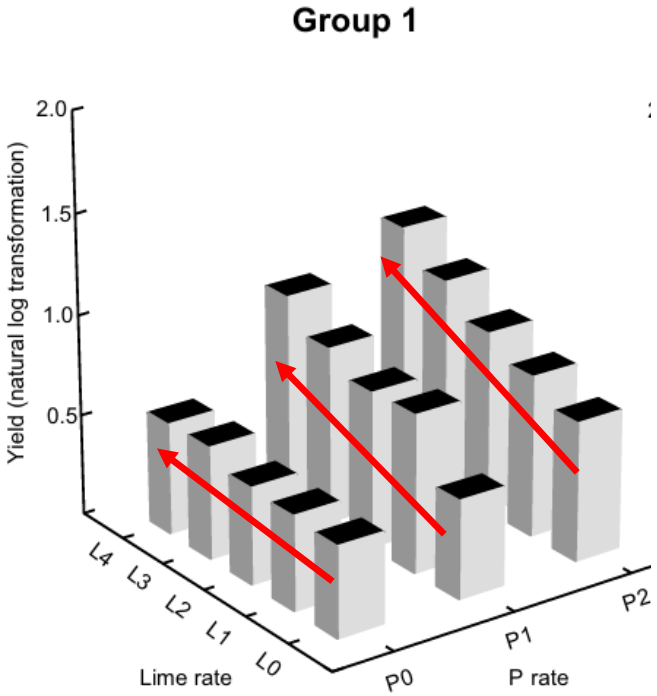


● Sampling time (n = 87)

1 = *P*<0.05; 2 = *P*<0.01; 3 = *P*<0.001

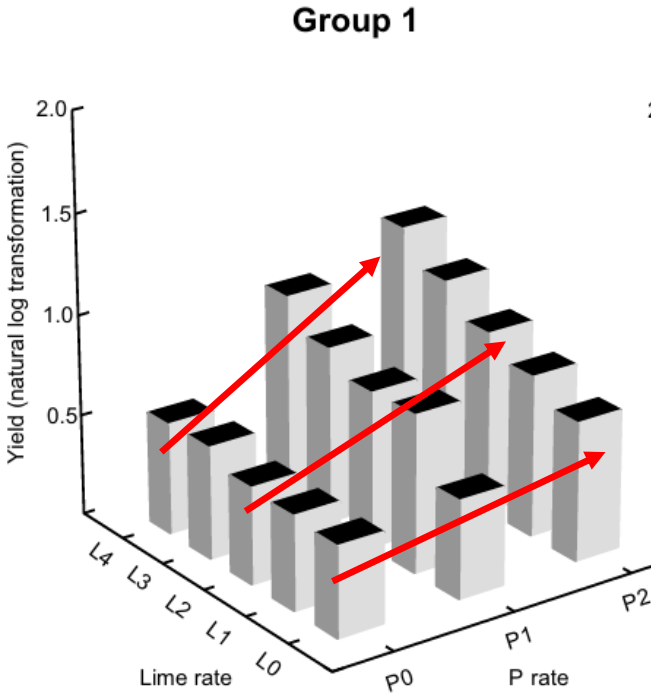
+ve response to lime with SSP

+ve response to SSP at L0-4



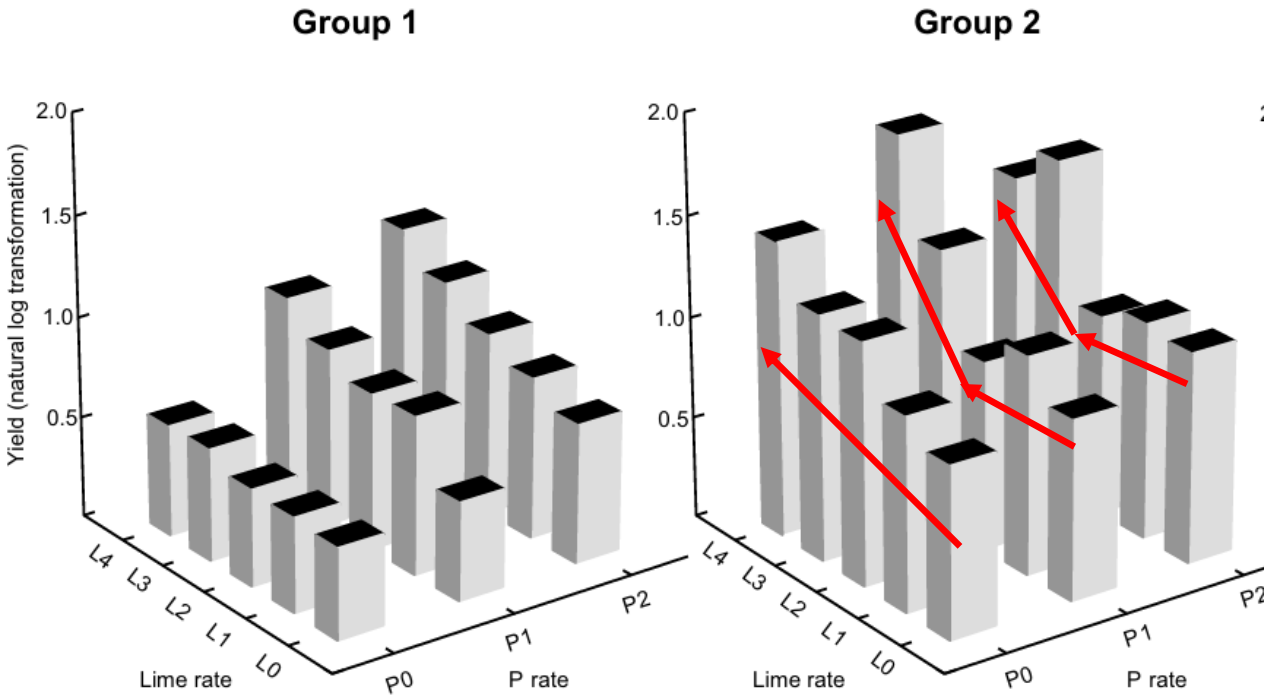
+ve response to lime with SSP

+ve response to SSP at L0-4



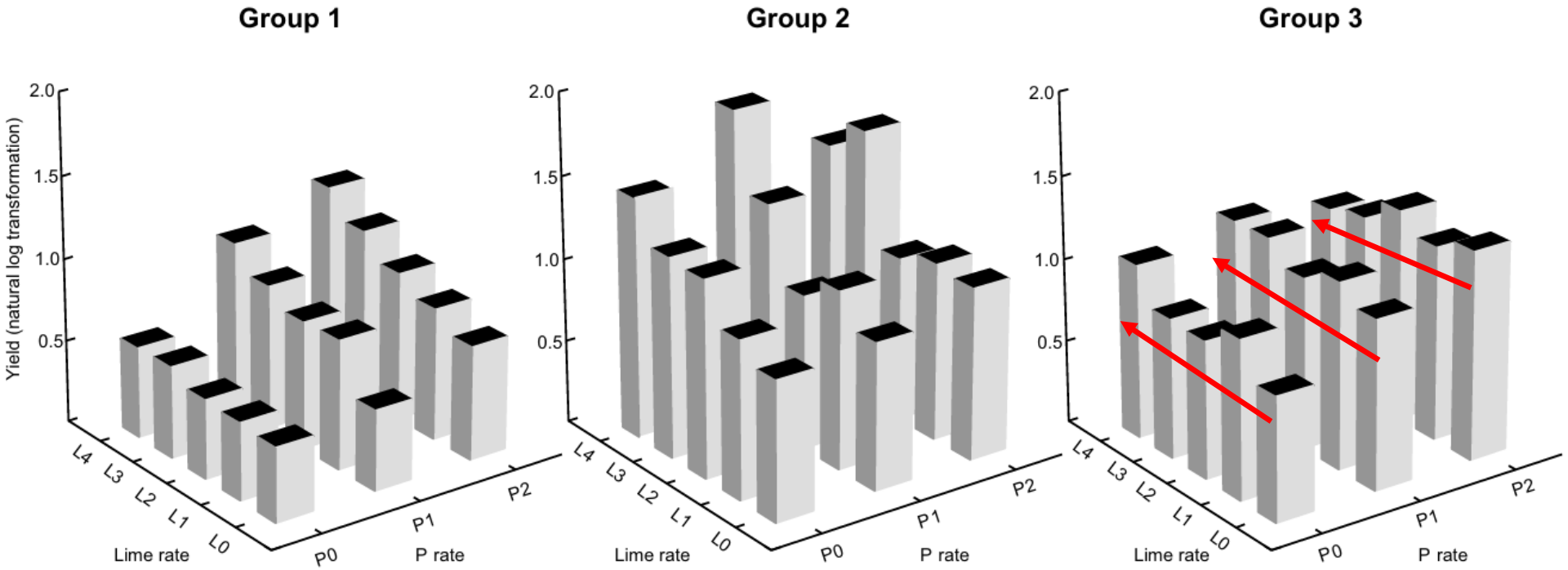
lime ↑ DM @ P0

@ P1-P2, ↑ DM only @ L3-4



Limited lime response

-ve lime response @ P2



Botanical composition, E2

Site	Component	1987	
		Mean	
		kg/ha	%
Mt David	*Phalaris aquatica*	28	0.7
	Lolium perenne	191	4.1
	Vulpia spp.	423	12.0
	Medicago sativa	195	4.1
	Trifolium repens	183	4.0
	Trifolium subterraneum	2936	73.4
	Rumex acetosella	21	0.5
	Hypochaeris radicata	7	0.3

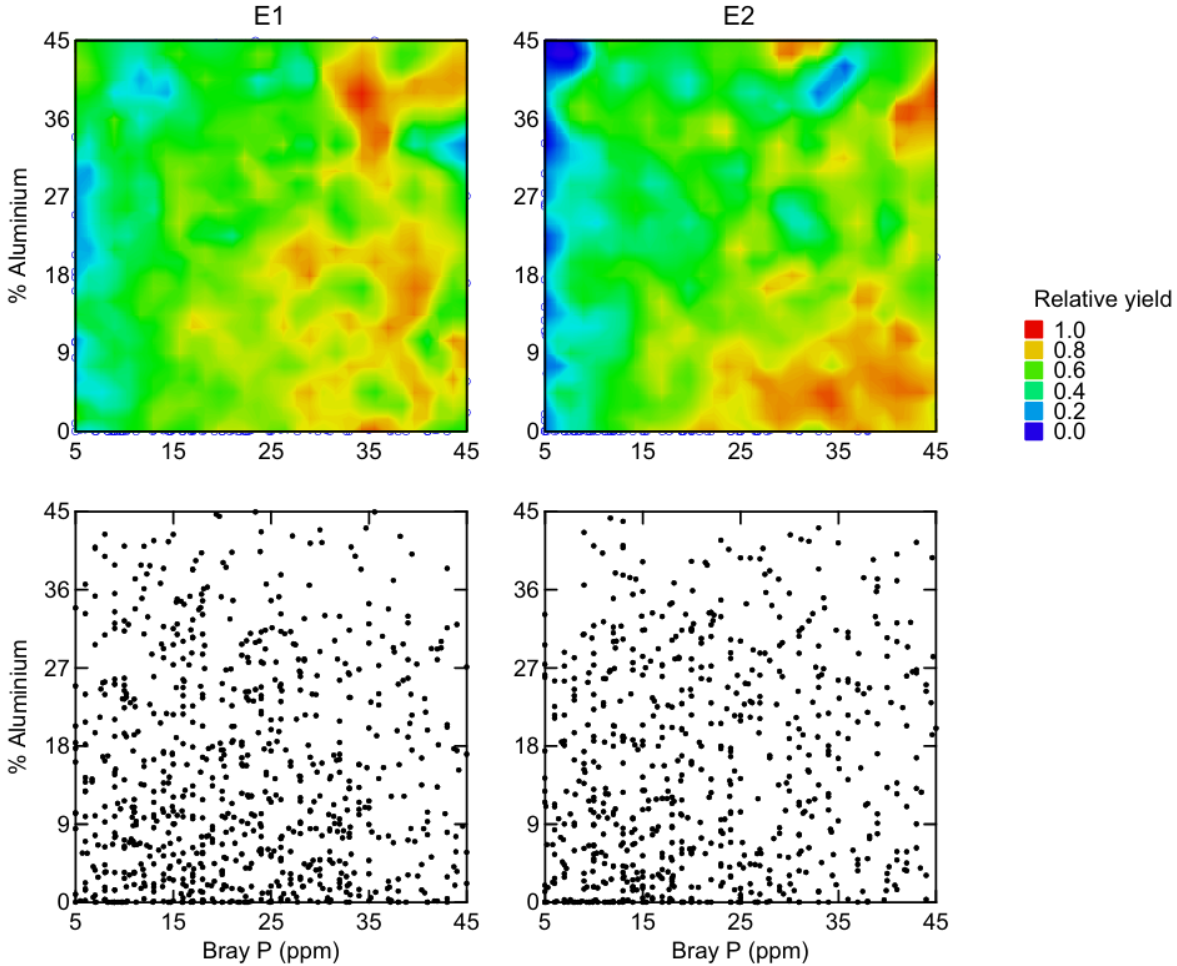
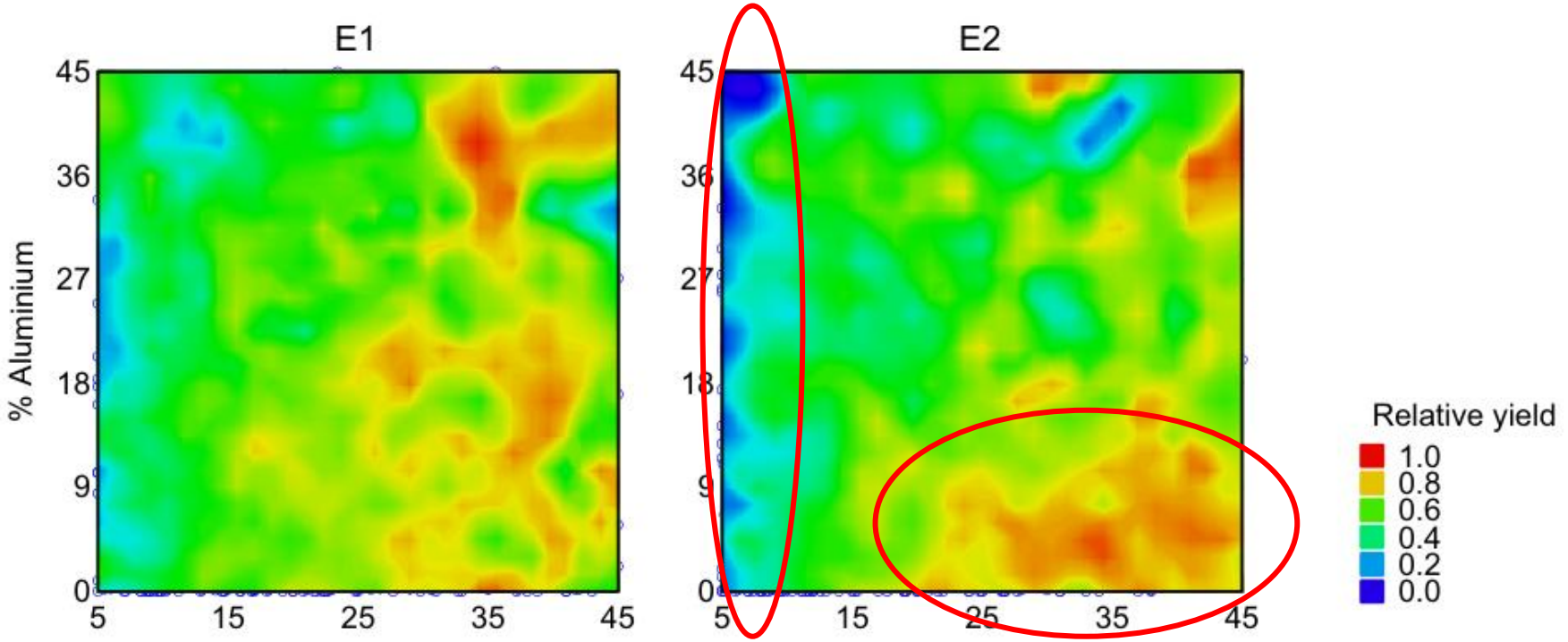


Fig. 7. 3D response of relative yield (all years; *Z*-axis, coloured) to Bray-1 P (*X*-axis) and %Al (*Y*-axis) in E1 and E2. Dots represent individual points. Data restricted to 5–45 Bray P mg/kg, and 0–45% Al.



Compared to E1, E2 species are more sensitive to:

- High %Al
- Low soil P

Responsive species?

Responsive pasture species …in mixtures?

Al Tolerance category (Al_{Ca} mg/L)	Pasture species
Highly sensitive (*0.1-0.4*)	Lucerne, medics, strawberry clover, Buffel grass, tall wheatgrass
Sensitive (*0.5-0.8*)	Phalaris, balansa, white Caucasian & red, clovers
Tolerant (*0.9-1.6*)	Chicory, sub clover, tall fescue, ryegrass
Highly tolerant (*1.7-2.7*)	Cocksfoot, kikuyu, paspalum yellow serradella

Upjohn *et al*. 2005

1. Lucerne
2. Phalaris
3. Chicory
4. Lucerne + Phalaris + Chicory

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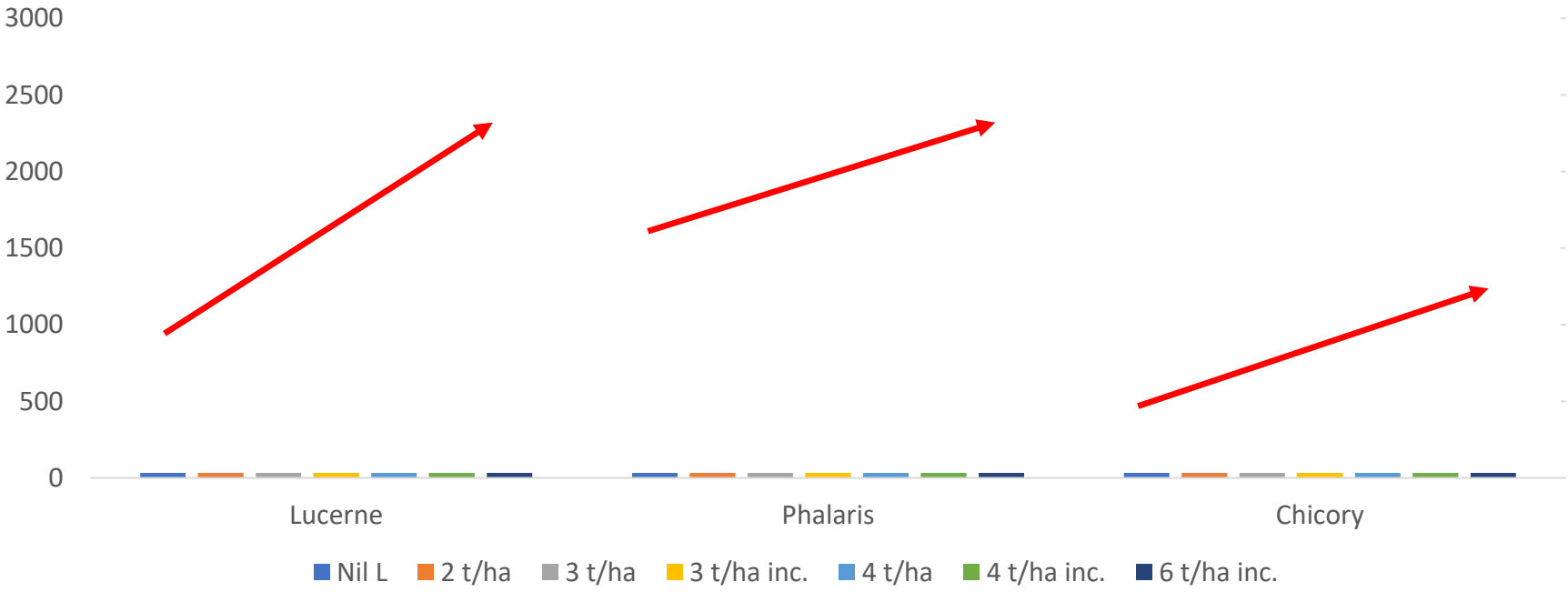
Response of perennials to soil treatment



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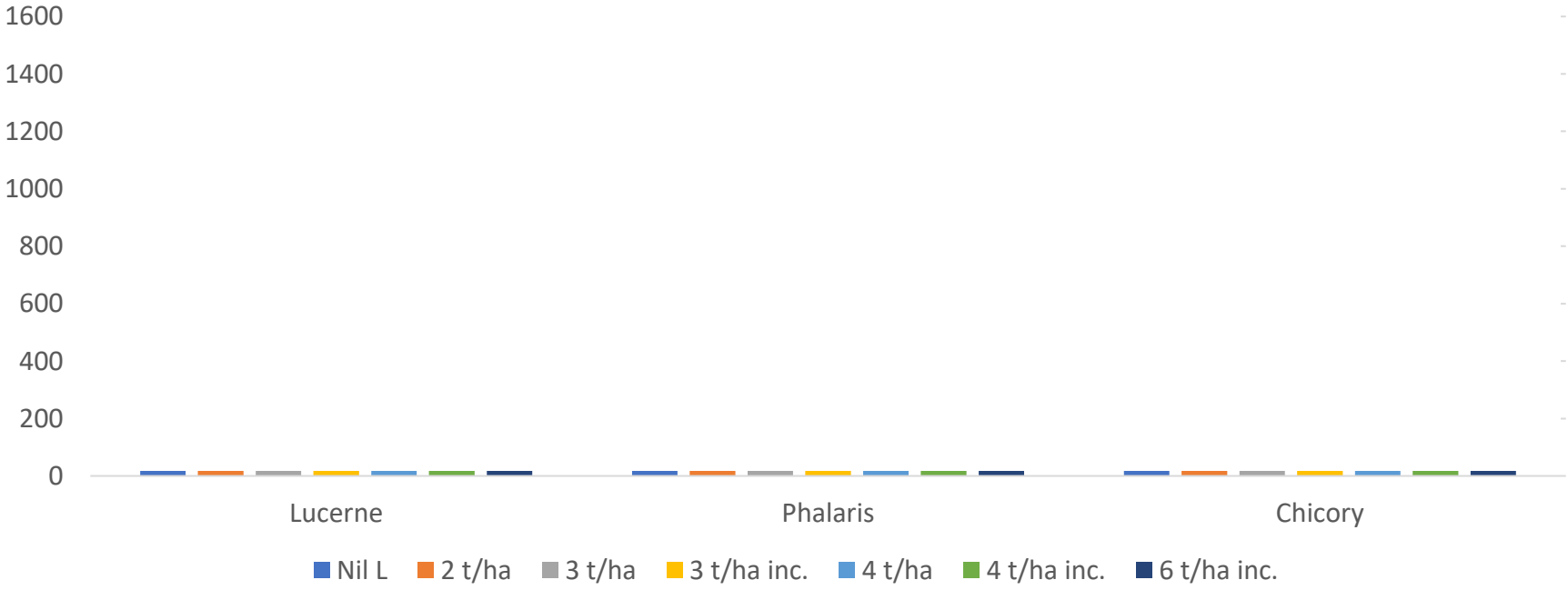
Response of perennials… in a mix



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Summary

- Response to lime may be variable
- Acid soil tolerance is not the only game in town
  - Response of companions
  - Agronomy (e.g. sowing time)
  - Grazing management
- Maximise the response to lime
  - Responsive species
  - ↓ weed content
  - Good agronomy (e.g. P fertiliser)
  - Grazing management (e.g. ↑ clover)

In Mixed Pastures…

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Conclusion

- Lime works!
- Its pasture management that makes lime pay
- The trick is to fit liming into your long-term program

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Liming
A producer's experience of tackling soil acidity

John Jervois

Jervois Pastoral

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About us…

- Tumbarumba NSW – Average Annual Rainfall – 980mm
- Currently approx. 18000 DSE (Mid winter DSE) 95% Beef 5% Composite Ewes producing Prime Lambs (PL)
- Beef: Target – 440kg Feeder Steers (15-17mths Age) Joining 95-100% Heifers 5 weeks, Cows Join 7 weeks, Calve 1st Sept, All dries sold
- PL: 5 week Joining – Lamb July 1, Everything gone by Christmas @ Target 25kg dressed Avg/Lamb on grass and some grain.
- 2016 – 650 Effective/ha
- 2017 - 880 Effective/ha
- Currently 1150 Effective/ha

Our Acid Soil Management Journey..

- Early days of liming late 90s early 2000s – Lime to establish pastures (after experiencing some failures)
- 2.5t/ha (Best practice rate every 10 years or so)
- Budget strategy was “what we save in commission, we will try to put that back into lime”
- Dad involved in PPP, Early Acid soils programs – Looked internally within business to increase productivity.
- What we were dealing with.. The Average values then…
- pH (CaCl2) 0-10cm 3.9-4.2, Aluminium 0-10cm 18% 10-20cm 27%, Colwell P 18
- Gravel Yard Pdk – pH (CaCl2) 0-10cm 3.9 Al 0-10 50% Al 10-20 72%

Mid way (2010 – 14)

- Continued lime pre new pasture (2.5t/ha)
- Declining pasture composition and productivity (measured in soil testing – good old “gut feel”) increased amount of annual weeds (end of that limimg cycle)
- Expand liming program from establishment pastures > liming existing pastures
- Topdressing of old pastures started 2.5-3t/ha
- Benchmarking our business started in 2013/14

2014 - Current

- Liming program expanded to more existing perennial pasture
- Base pastures of Phalaris, Perennial Rye. Whiteclover and Subclover – Limed for Second & third time
- Pasture response – Increased Perennial Component, Sub clover initially then Perennial grasses. Decrease in perennial weeds (Bent and Cooch). Decrease in Annual grass weeds. More P & N applications.
- Pasture response = increased stocking rate, “broaden the shoulders” of the season
- Property purchases started to happen 2016 – Current
- “Woodstock South” Purchased
- Involvement – “Core Producer” HLN MLA

Our decision process to go harder with lime.
(Remember the Gravel Yard pdk?)

Going harder with lime “Woodstock South aka The swamp”

- Back to front transformation discussion with bank
- Lime and new Pastures (plus some cultivation)
- Lime at rates which we had never considered before, and the frequency not done before
- 3t/ha new pastures
- 3t/ha Existing pastures and again within 3 years 3t/ha again
- Higher $/DSE profit but higher land purchase price/acre
- Visual appearance – dried out the pdks, better water use? Deeper roots?

Looking back..

- Evaluate what pasture you have (Just this once.. Getting bogged payed off!)
- Seek advice (Farmer & Industry)
- Know your numbers.
- Liming –slow burn.. Increasing soil pH and increasing fertility – Increase DSE/ha

Thanks!

- HLN & MLA “Producer Demonstration site “Managing Soil Acidity in Permanent Pastures (L.PDS.2209)
- Jervois Family