



Achieving better soil acidity management in Western Australia

– 3 decades of investment, research and awareness-raising projects

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Dryland cropping

May–Oct rainfall 225–450 mm

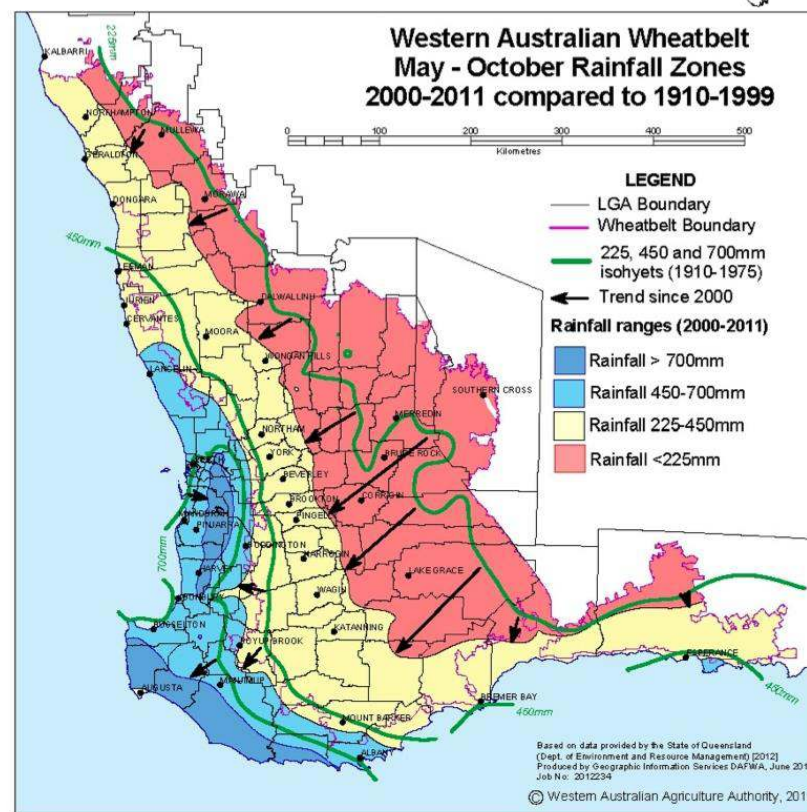
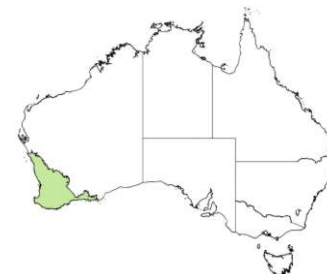
**Ancient, highly weathered sandy
soils, generally acidic**

Dominant crops

- wheat
- barley
- canola
- lupin
- and pasture

Agricultural lime mostly coastal

- 100 – 400 km



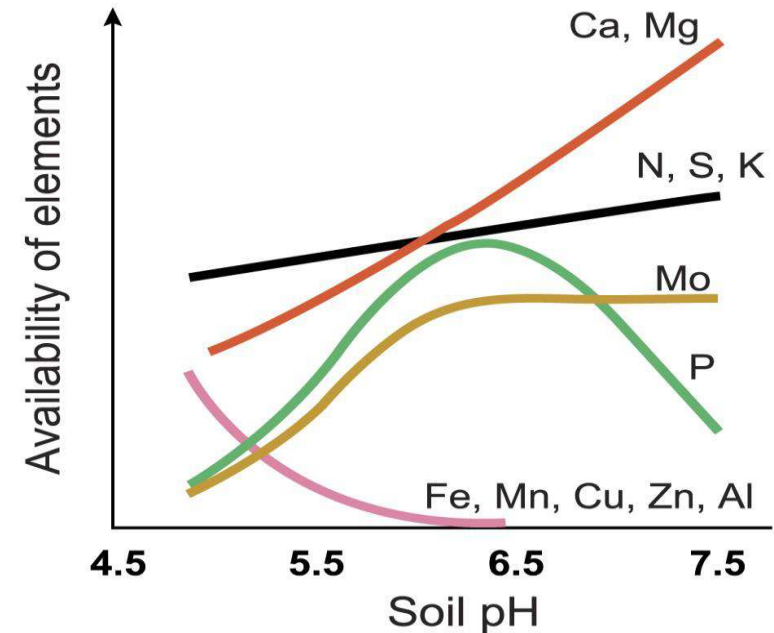
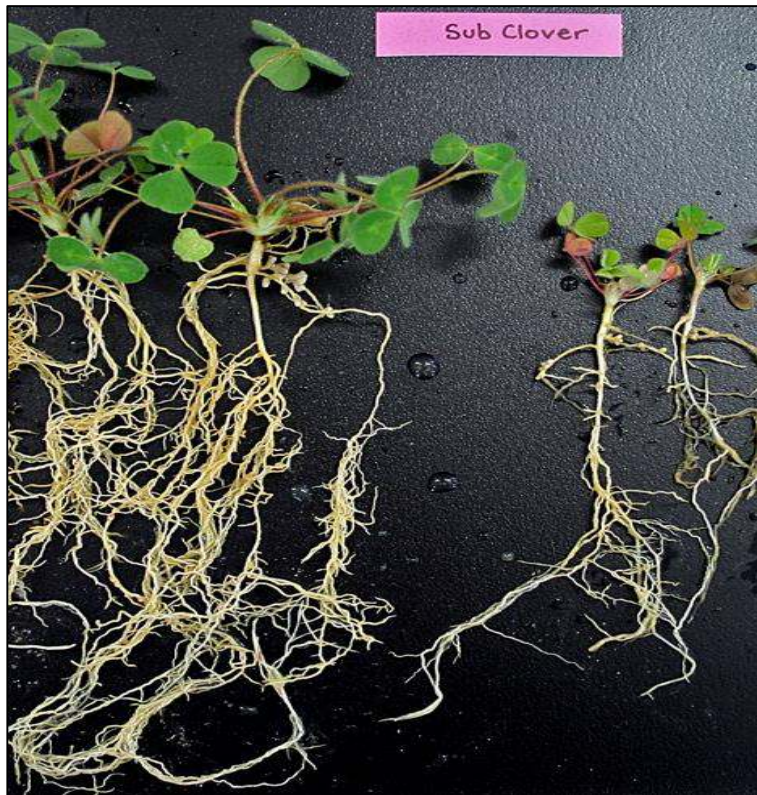
- **WA lime trials 15 – 20 years**
- **Major awareness and soil testing projects 2005 – 2012**
- **More effective use of agricultural lime**





• Topsoil acidity

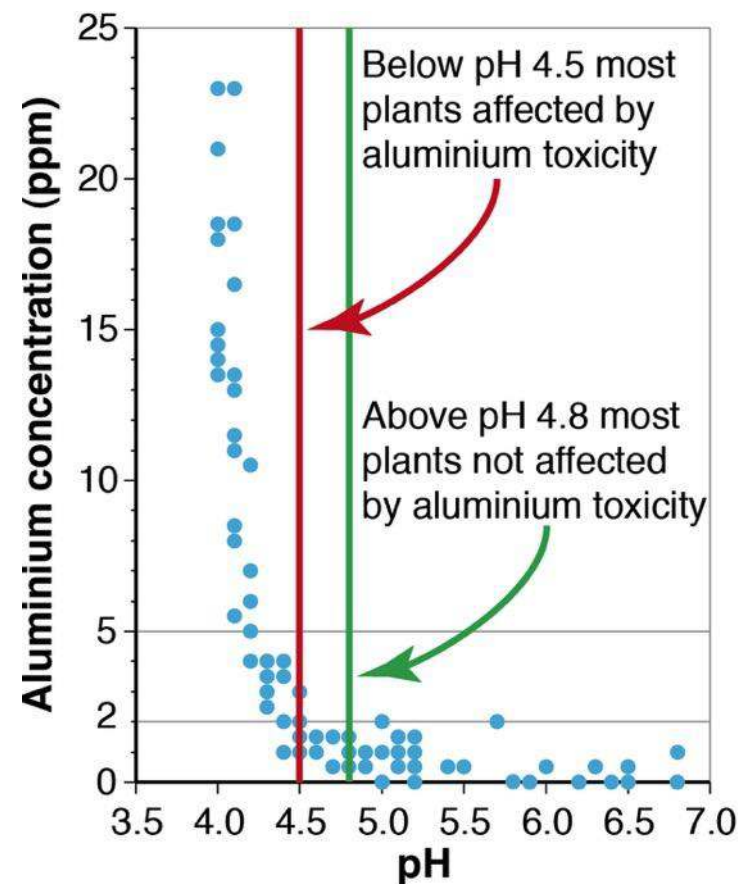
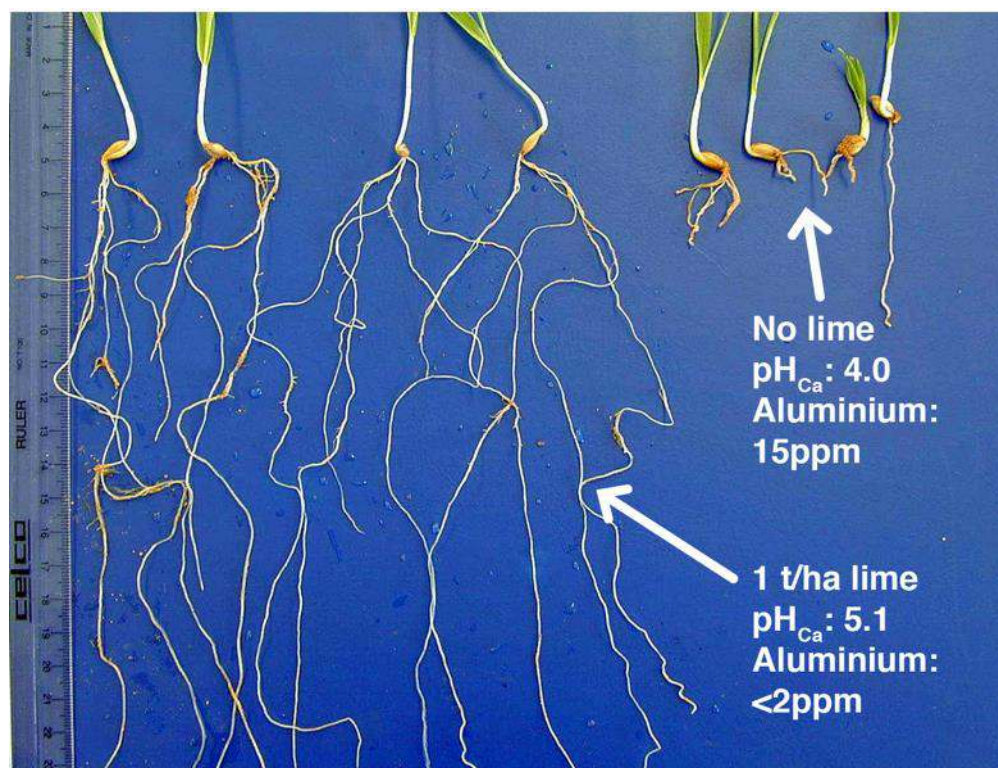
- Reduced biological activity
- Reduced legume nodulation
- Reduced nutrient availability





Minimum desirable pH

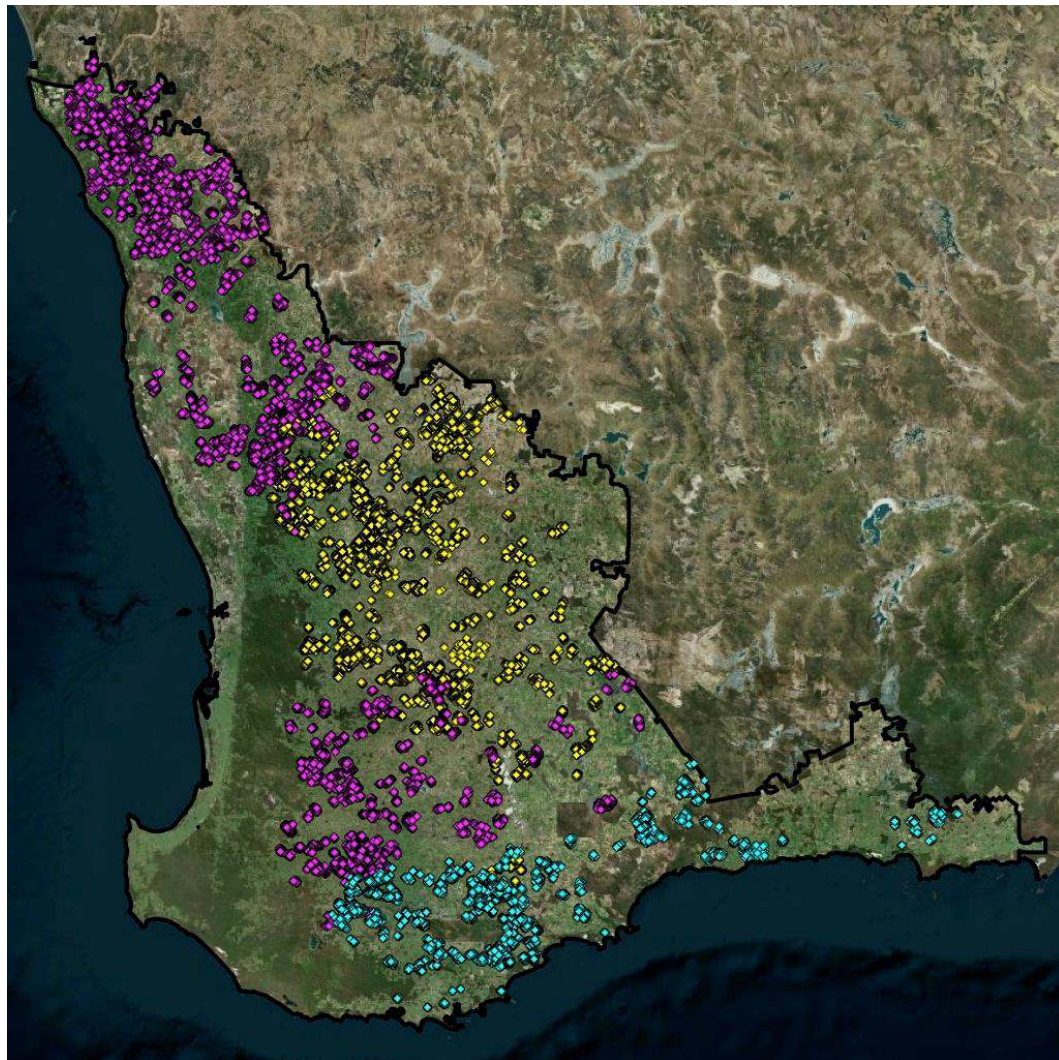
- Target for topsoil pH is 5.5_{Ca} and for subsoil pH 4.8_{Ca}





• Major findings

- Growers' paddocks have mirrored the control or under-limed trial treatments
- 72 per cent of surface soil samples below minimum target (pH_{Ca} 5.5)
- 45 per cent of subsurface soil samples below minimum target (pH_{Ca} 4.8)
- Project and commercial samples – over 93 000 sites

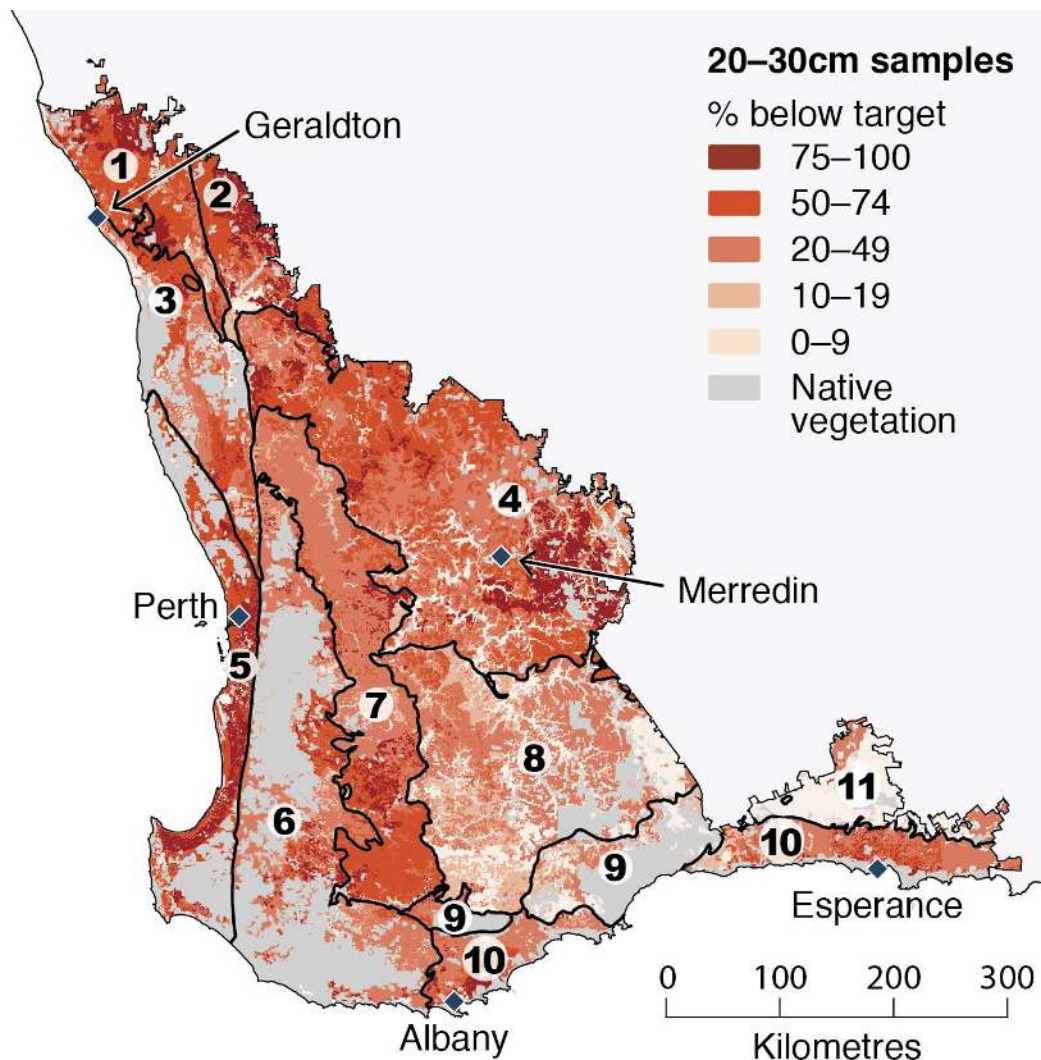




Soil testing projects 2005 – 2012

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7. Zone of Rejuvenated Drainage

- Per cent of samples below target pH

Soil Type	% of Zone	Topsoil target pH _{Ca} 5.5	Subsurface target pH _{Ca} 4.8	
		0–10 cm	10–20 cm	20–30 cm
All soils	100	74	47	40
Deep sandy duplexes	55	87	52	41
Gravels	11	68	46	40
Deep loamy duplexes and earths	7	64	40	30



A coordinated approach has created widespread awareness

- growers
- consultants
- researchers

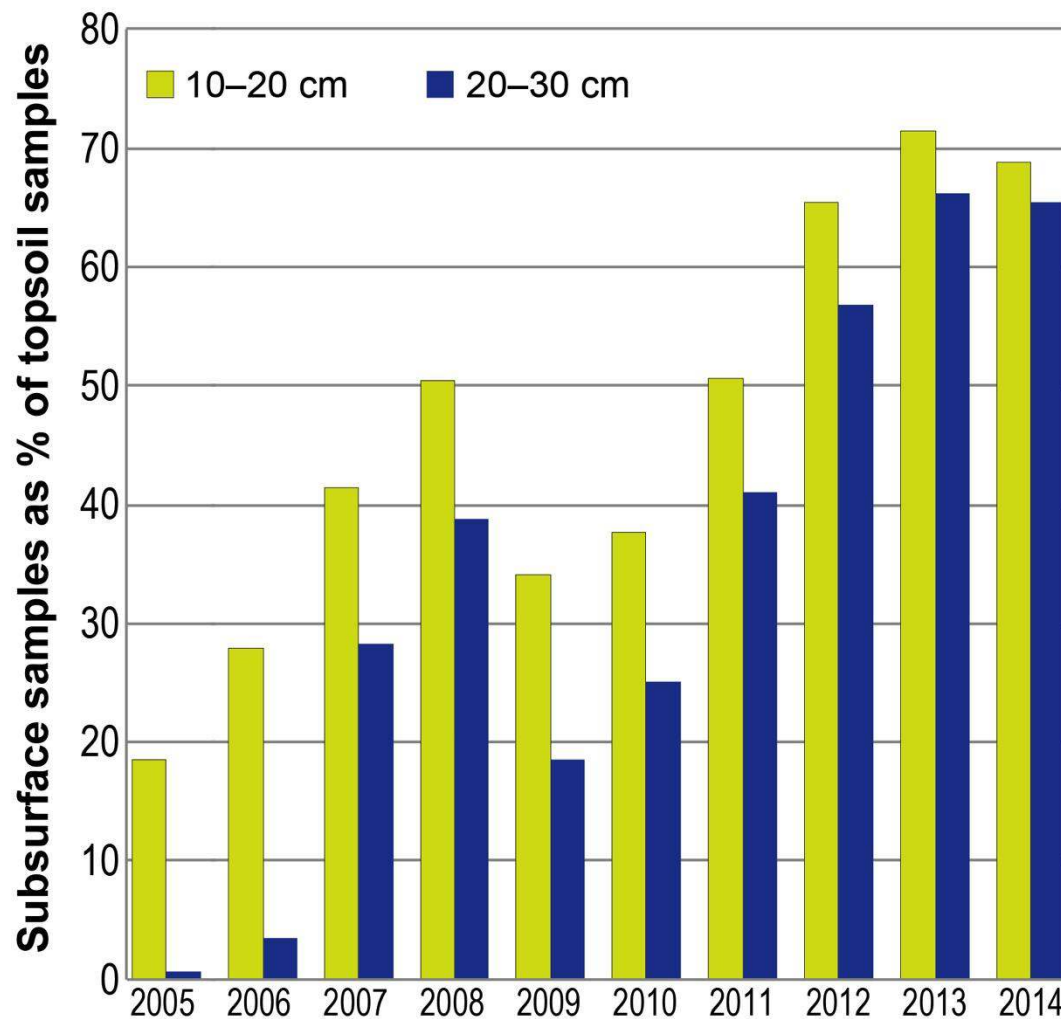
Accelerated change in practice is happening

- subsurface soil sampling
- increased lime use

Number of samples

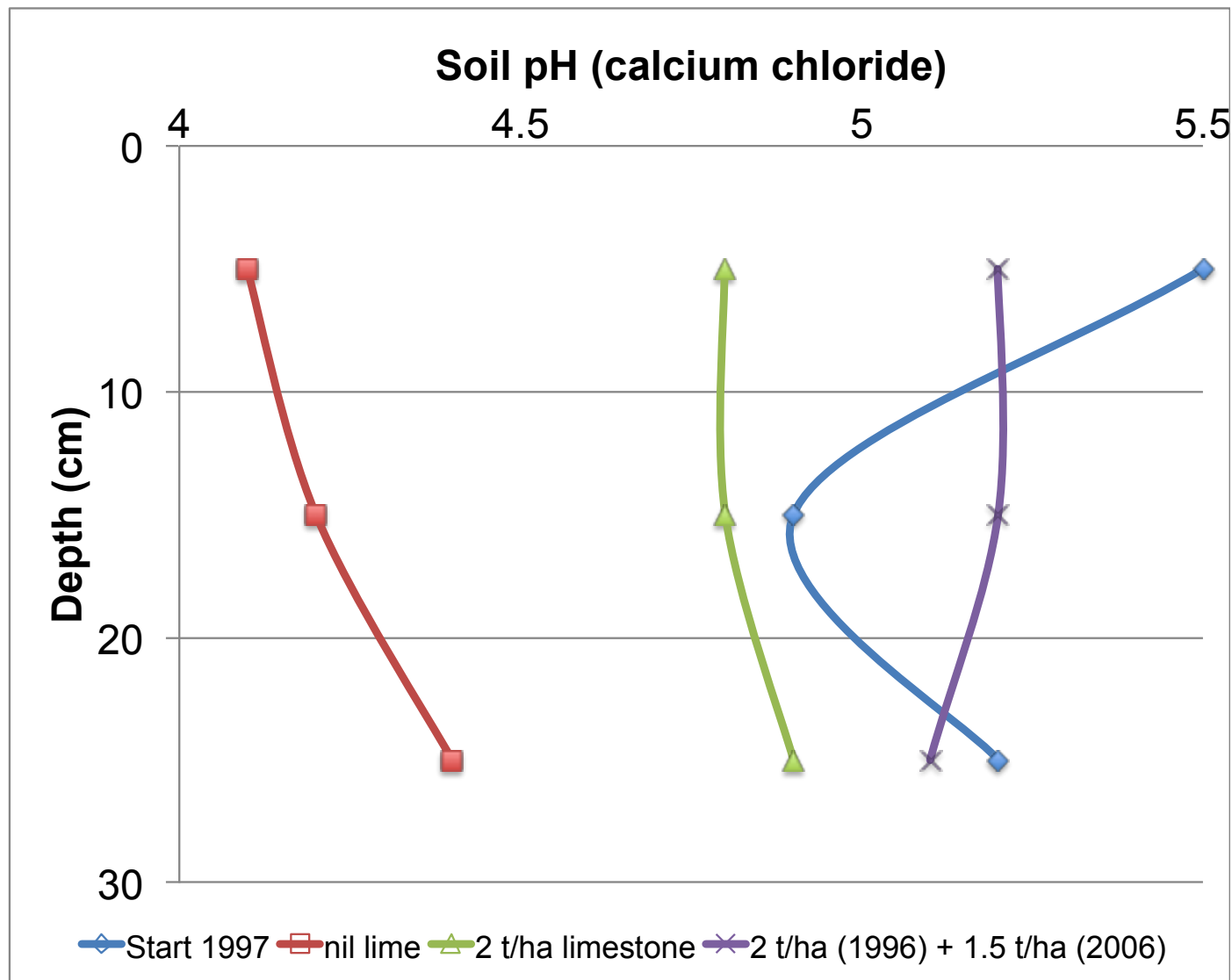
- 2005 topsoil n = 11240
- 2014 topsoil n = 18815

Subsurface soil samples as a proportion of topsoil samples collected by Precision SoilTech





2016 soil pH for 1996 Newdegate trial





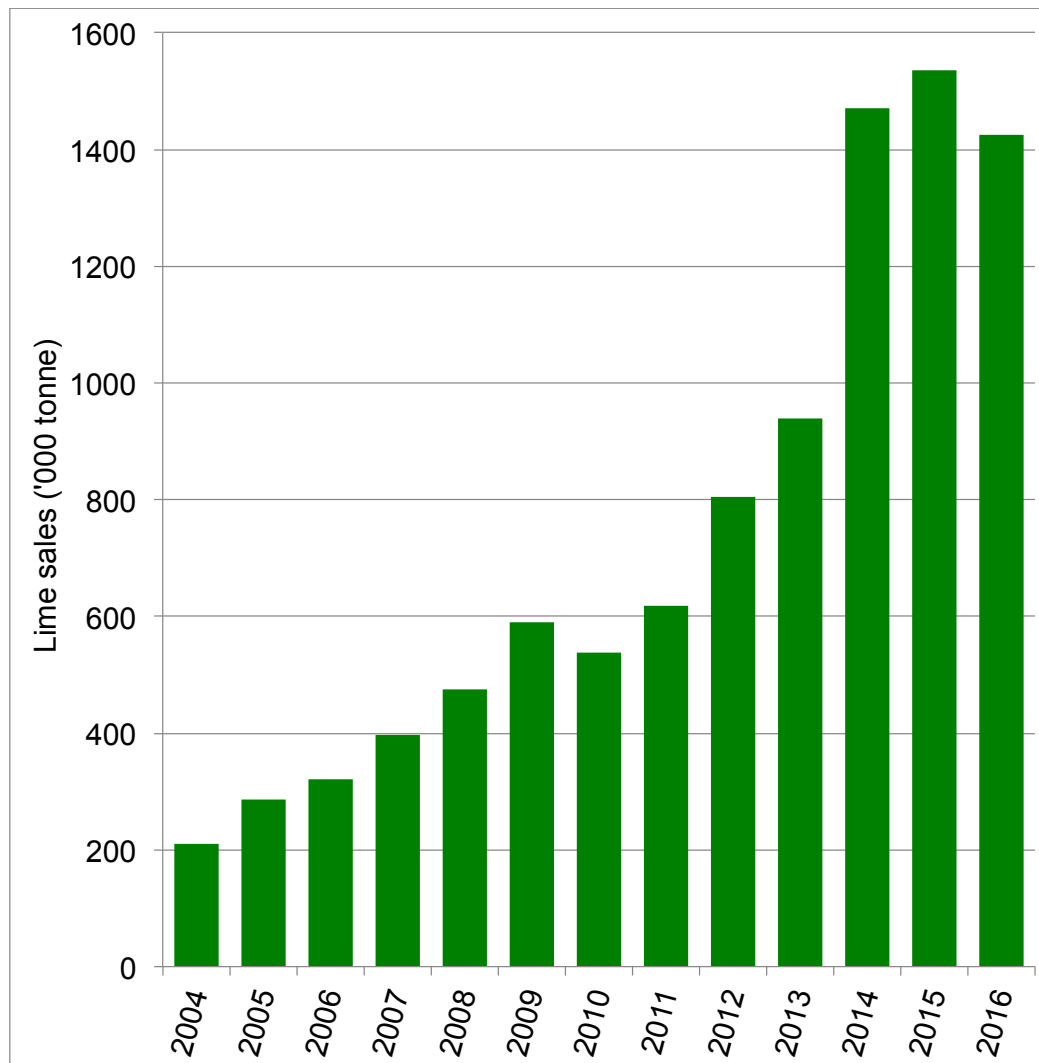
Agricultural lime use – Lime WA

• Insufficient

- 2014 – 2015 was 1.4 – 1.5 million tonnes
- 70 per cent of the estimated annual lime requirement

• Target

- 2.5 million tonnes per year for 10 years



Current members
~80 per cent of market share



LIME WA INC.
Accredited Lime Suppliers



• Stratified profile

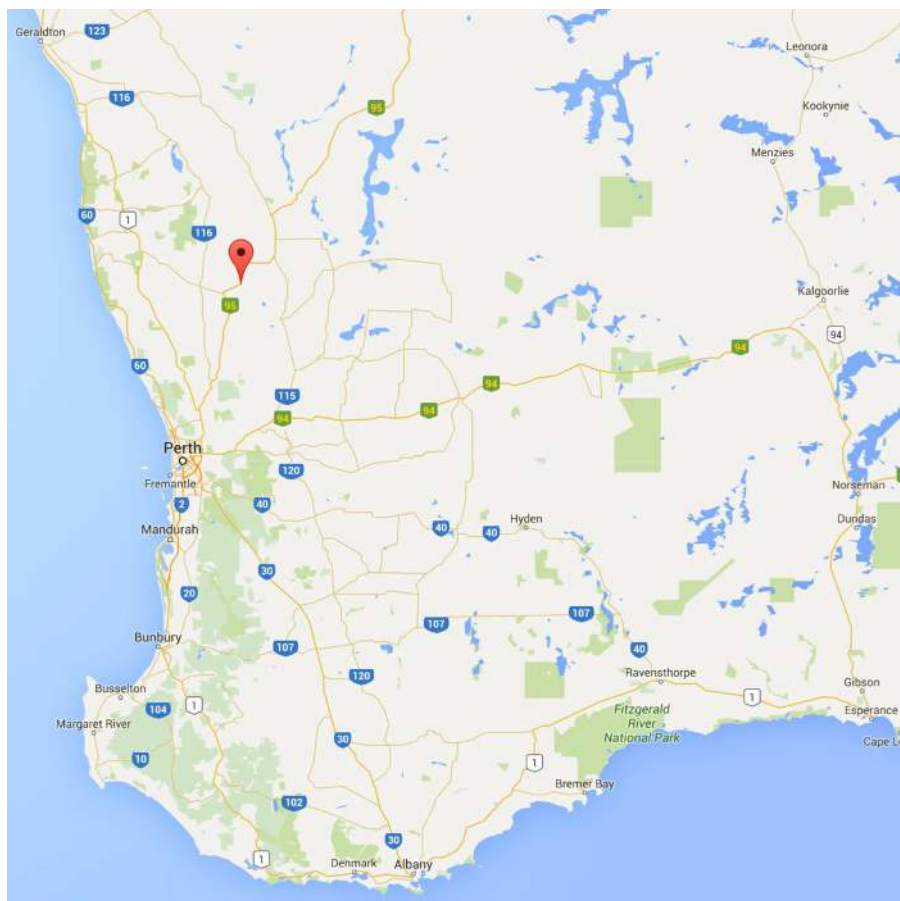
- Lime typically topdressed
- Often insufficient applied to raise pH adequately
 - development of an acidified profile
- No-till farming has decreased incorporation
- Separation of the lime and the acidic layers

• Implications

- Soil sampling
- Fertiliser recommendations



- **2014 Barley harvest, 1996 trial at Bindi Bindi, WA**
- **200 km north of Perth**





- **2014 Barley harvest, 1996 trial at Bindi Bindi, WA**

- Detrimental effects of soil acidity (low soil pH) can be overcome but may take years

- Insufficient lime results in a declining soil pH profile
 - yield penalties
 - deeper and more severe acidity



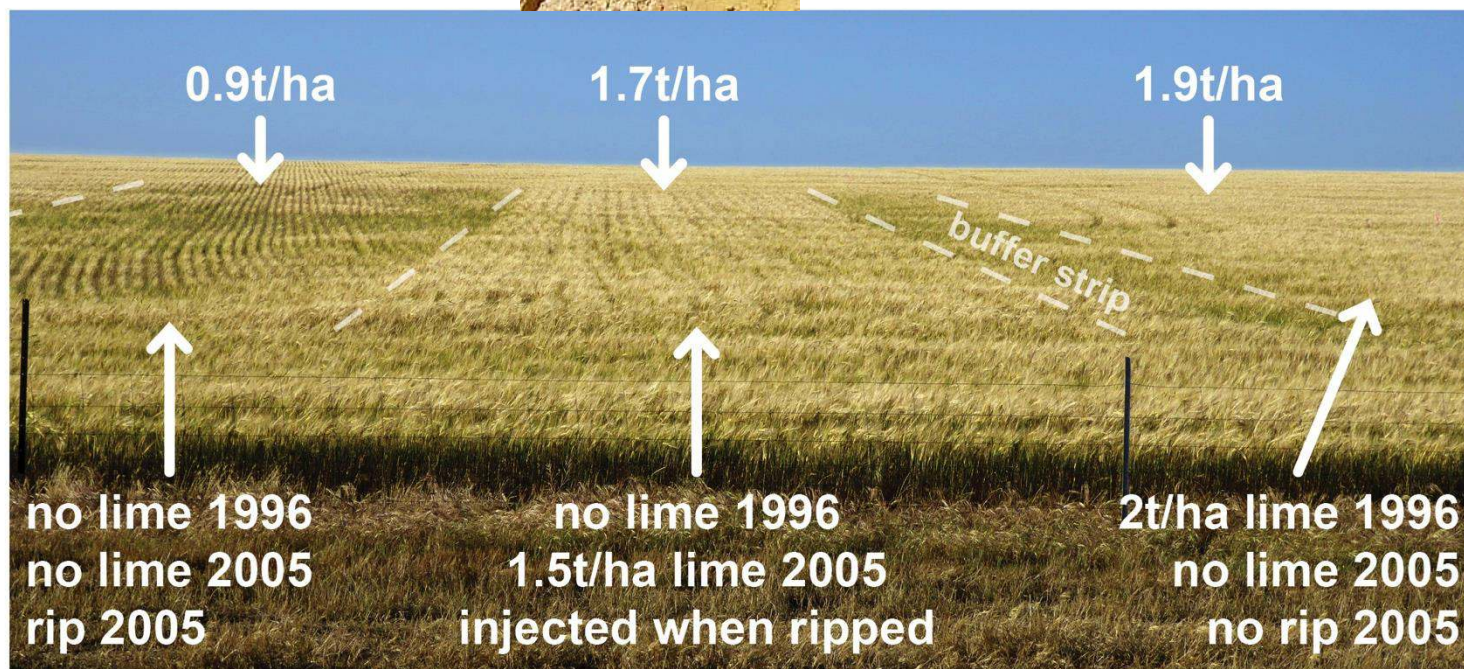


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Early management of soil acidity in the surface is by far the best

- A response to lime indicates that a loss has been incurred
- Challenge for how to assess return on investment

Tillage more than a plough for top 10–15 cm probably not suitable for a lot of the soil types

- Rocks
- Roots
- Hostile subsoils on duplexes





Strategic tillage – multiple benefits

- Puts lime where it is needed, creates pathways for roots
- Can treat compaction
- Redistributes nutrients
- Ameliorates water repellence
- Incorporates soil organic matter
- Buries herbicide resistant weed seeds



BUT

- Wind erosion
- Surface sealing
- Toxic soil to surface
- Rocks, roots...
- All the usual risks which led to no-till





Deep ripped surface applied lime



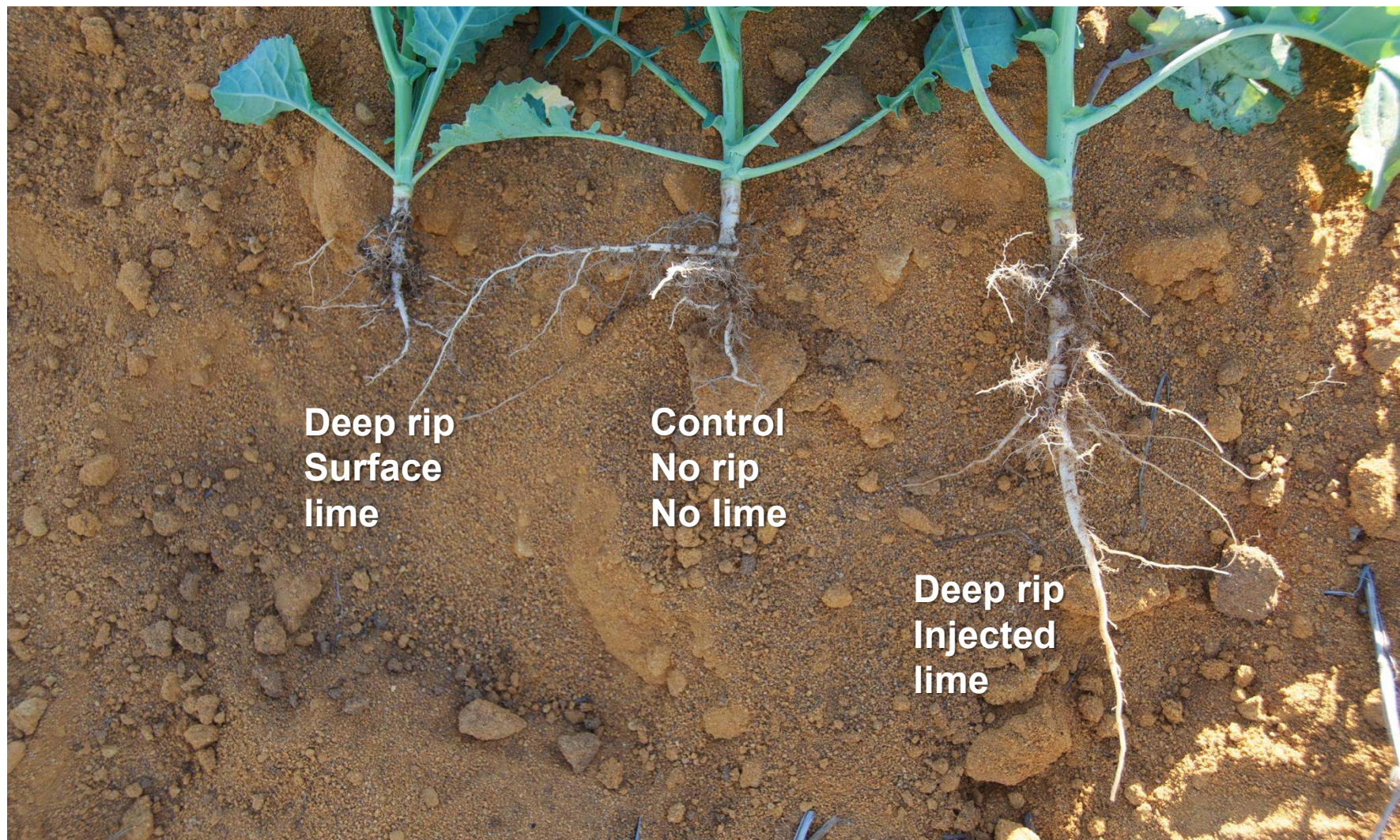


Deep ripped injected lime





Canola root response





Lime incorporation – canola roots





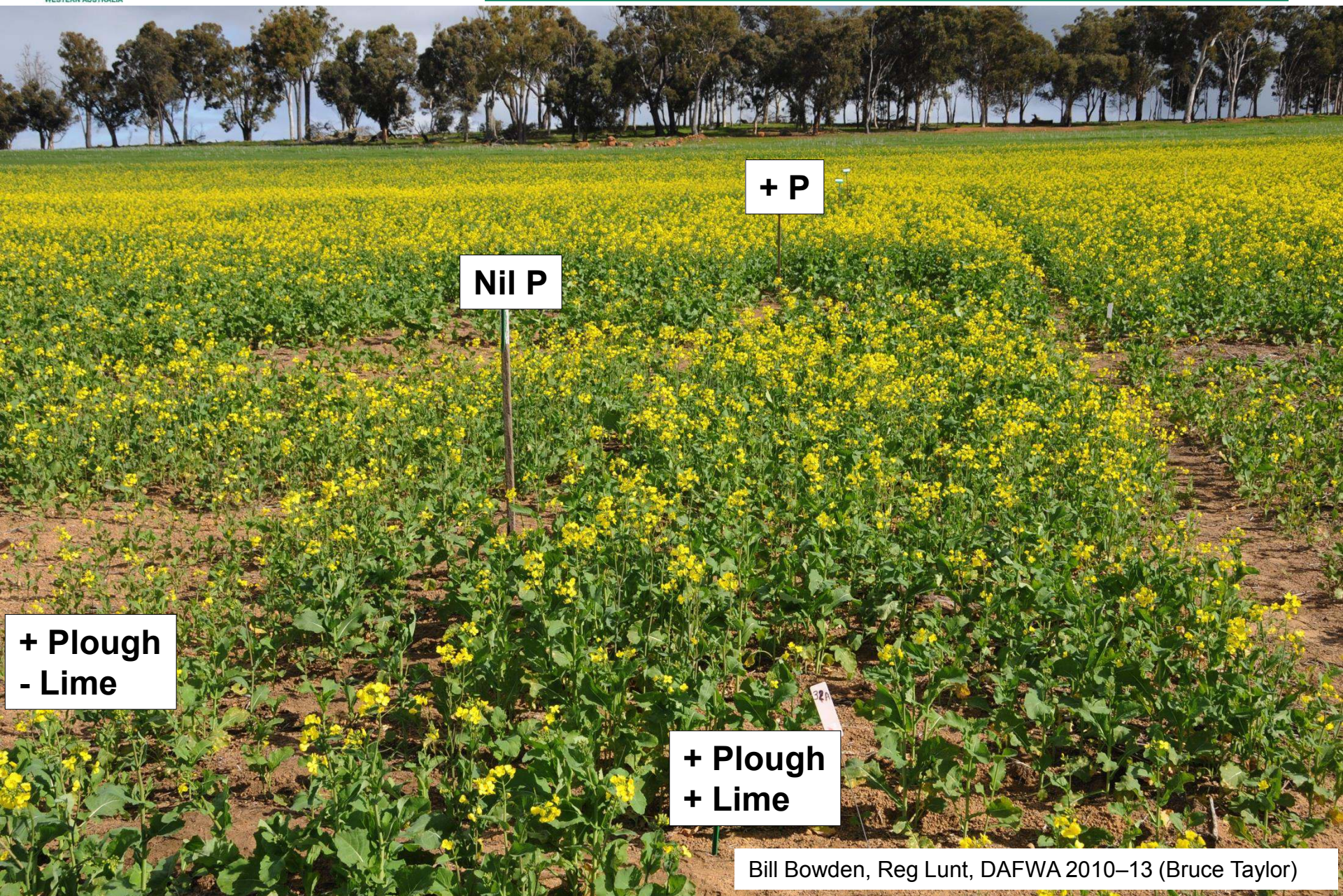
Lime incorporation – canola roots



Topsoil incorporated behind inclusion plates



Topsoil nutrition trial results – Darkan



Nil P

+ P

**+ Plough
+ Lime**

Bill Bowden, Reg Lunt, DAFWA 2010–13 (Bruce Taylor)

**+ Plough
- Lime**



Acidification rate is mainly influenced by two factors

- N losses through leaching
- product removal (harvesting)

Typical acidification rates

(kg lime per ha per year)

- Crop–Pasture rotation 25–345
- Continuous crop 170–320
- Average 110–220



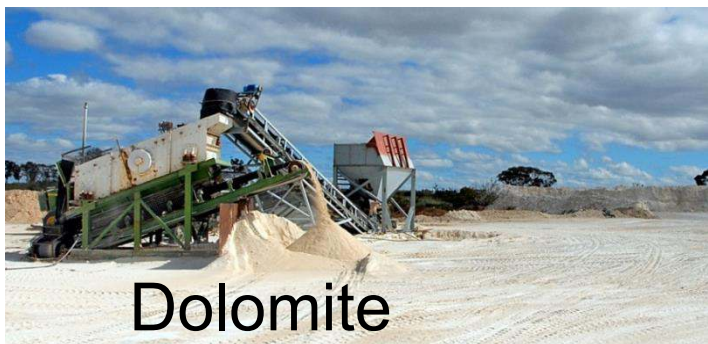
- 1–2 t/ha in 10 years for maintenance only
- Up to 2.9 t/ha 10 years for maintenance only (70% NV lime)



Limesand



Limestone



Dolomite





- DAFWA independent audit
- Lime WA Inc suppliers
www.limewa.com.au
- Calculator
www.soilquality.org.au



Lime WA Member details

This shows that it is a Lime WA product information sheet and indicates the laboratory that tested the product

XYZ LIME SUPPLIERS

PO BOX 123
NEARBYYOU
WA 6777

Tel : 9111 7777
Fax : 9111 8888

LIME WA INC.

Independently Audited Lime Suppliers

Product Information Sheet

Tested by an Approved Laboratory

ChemCentre NO NO Agrifood TECHNOLOGY

GENERAL INFORMATION			
Pit Name	XYZ	Date of Analysis	Current Audit Sample
Location	Nearbyyou	Laboratory No.	15A308-01161
Product Description	Limestone	Product Screened	Yes
Weigh System	ABC Loader Scales *	Screen Size (mm)	1.0mm
*** This supplier uses an accredited weigh system verified by the Department of Consumer Protection			

Current NV for each particle group

CODE OF PRACTICE APPROVED LABORATORY REPORT				
	AUDIT SAMPLE	AUDIT RANGE FOR PIT	AUDIT SAMPLE	AUDIT RANGE FOR PIT
Sieve Range (mm)	% Weight		% Neutralizing Value	
0.000 - 0.125	3.9	2.5 - 3.9	88.9	88.9 - 91.0
0.125 - 0.250	26.6	26.6 - 40.8	86.2	86.2 - 90.9
0.250 - 0.500	32.6	32.6 - 39.5	91.3	91.3 - 92.5
0.500 - 1.000	30.2	16.2 - 30.2	67.2	6372 - 81.9
> 1.000	6.7	2.2 - 6.7	60.0	58.0 - 70.1
Weighted Average NV			83.0	82.3 - 90.4
Bulk NV	81.0	81.0 - 92.1		
Calcium (Ca) (1 M HCl)	30.3	30.3 - 32.1		
Magnesium (Mg) (1 M HCl)	1.6	1.6		
Sodium (Na) (1 M HCl)	0.2	0.2 - 0.3		

Historical fineness of product by % of weight

Most recent fineness of the product by % of weight

Historical NV for each particle group

Statement by Supplier : The above analysis, provided by a Code of Practice approved laboratory, is a true representation of the product being supplied from the nominated pit. Pit ranges have been calculated from the last three samples analysed.

Date : Name : Signature :

Disclaimer : Lime WA Inc. requires members to provide the above details in accordance with the industry Code of Practice requirements but makes no claims and provides no guarantees on the quality or suitability of the product supplied. Product supplied by Lime WA Inc. members occurs naturally and has a moisture retention capacity that varies according to seasonal conditions. As this cannot be controlled by suppliers, moisture level analyses are not included on this information sheet. Lime WA Inc. is not responsible for any claims and/or liabilities arising from the supply and/or use of the product supplied. However, users are invited to contact the Association on 0419 575 737 in the event of any dissatisfaction with the product description provided by accredited Lime suppliers.

Most recent bulk NV, Ca, Mg and Na

Historical bulk NV, Ca, Mg and Na

This logo indicates this is a DAFWA audit test



Measure and monitor

- Soil type and starting pH profile
 - Enterprise – crop(s)/pasture
 - Productivity – removal off farm
 - Type of N fertiliser and how much nitrate leached
-
- Use professional advice for recommendations which take all factors into consideration
 - The 'Rule of Thumb' can provide a guide



Soil depth	pH	Lime amount over 5 years
0–10 cm	under 5	2 t/ha
	under 5.5	1 t/ha
** PLUS **		
10–20 cm	under 4.5	2 t/ha
	under 4.8	1 t/ha
** PLUS **		
20–30 cm	under 4.5	1 t/ha
	under 4.8	measure pH in 3 years



Our key messages for farmers

- Farming acidifies the soil
- Understand lime requirements across the farm – don't apply blanket rates
- Take lime quality into consideration when calculating rates and cost
- Target lime to where it's needed – treat topsoil early to prevent subsurface acidity if possible
- Consider incorporation for a faster response and/or to tackle multiple constraints





- **Extensive lime trials**

- Yield responses indicate acidity is a constraint to production

- **Awareness**

- Subsurface acidity
- Acidification rates

- **Current research focus**

- Strategic tillage to incorporate lime
- Improve return on investment (effective use of lime)
- ***address multiple constraints to achieve and maintain multiple benefits***



Department of
Agriculture and Food



Bulletin 4858



Soil acidity

A guide for WA farmers
and consultants

Second edition

Supporting your success

Acknowledgement:
GRDC projects
DAW00236 & DAW00252

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Department of
Agriculture and Food





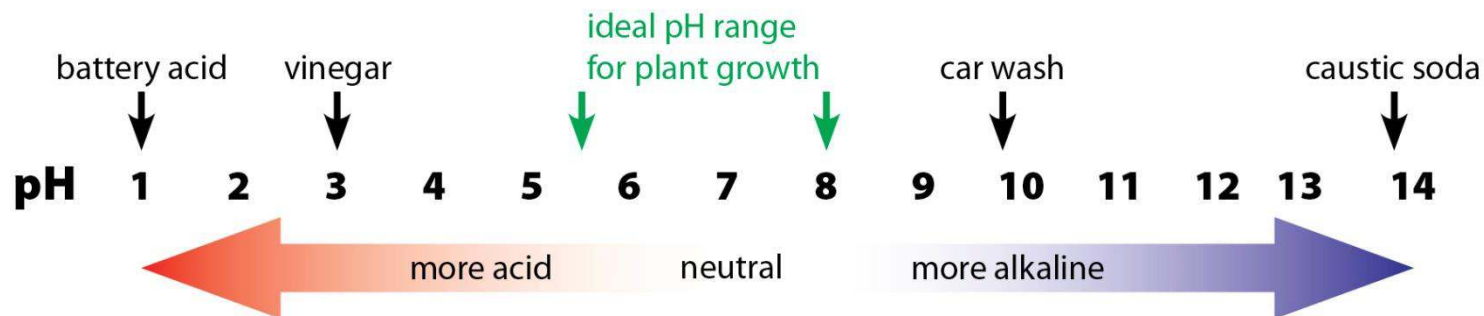
Any soil with a pH below 7

- **For farming purposes it is a soil** with a pH low enough to have a detrimental effect on biological activity and plant
- Soil acidity costs WA upto \$1 billion per year
- 72% topsoils below target ($\text{pH}_{\text{Ca}} < 5.5$)
- 45% subsurface below target ($\text{pH}_{\text{Ca}} < 4.8$)
- 68% of growers report soils acidity to be a moderate or greater problem on their farm



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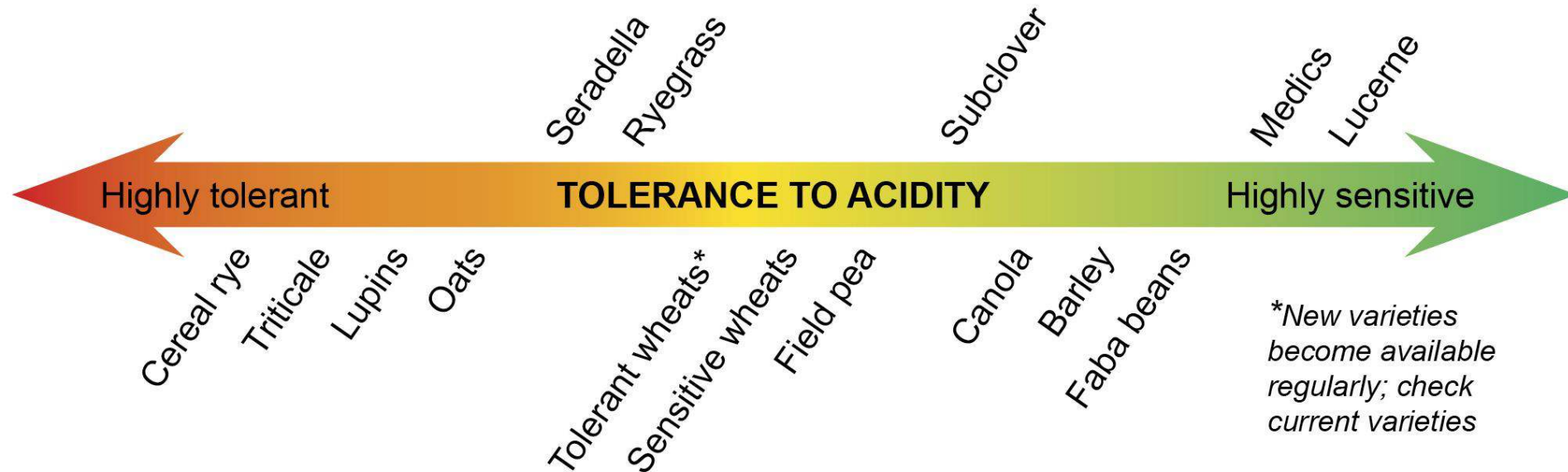


- **pH is a measure of the amount of acid or alkali in a solution**
 - Importantly it is a log scale
 - Small changes in the number mean large changes in the concentration
- **Example**
 - At pH 7 (neutral equal amounts of acid and alkali)
 - At pH 5 there is 10 times more acid than at pH 6
 - At pH 4 there is 10 times more acid than at pH 5 but **100 times** more than at pH 6



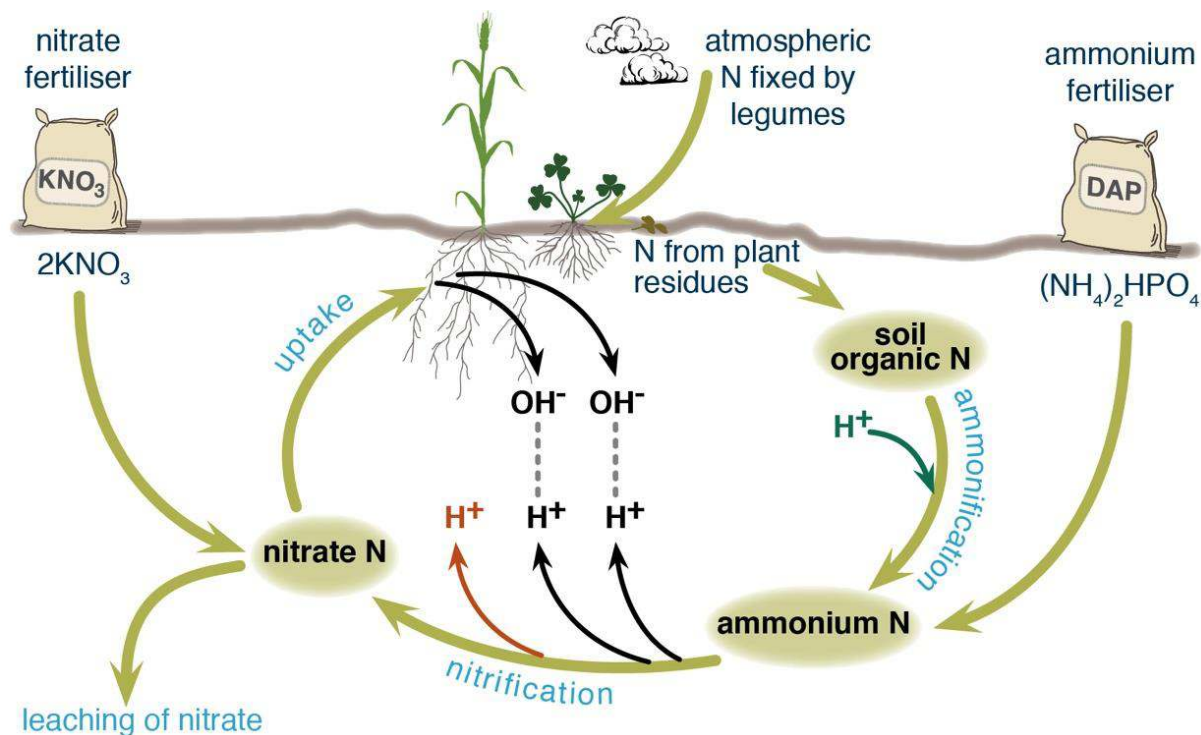
Any soil with a pH below 7

- **For farming purposes it is a soil** with a pH low enough to have a detrimental effect on biological activity and plant growth





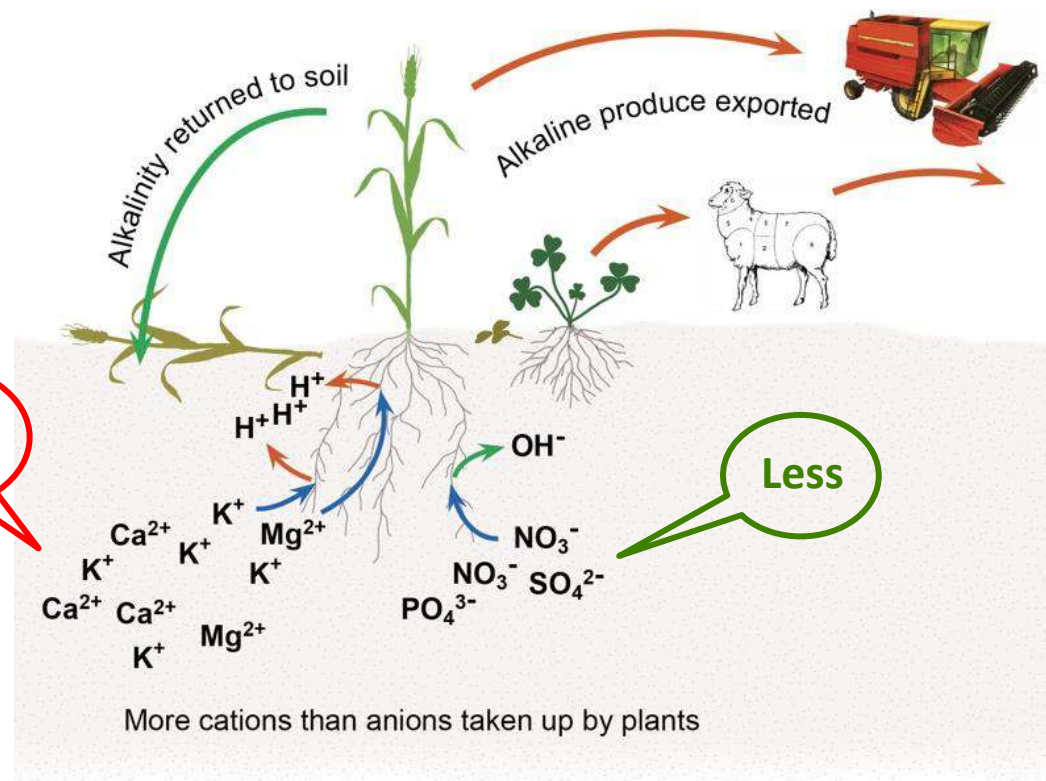
Why are our soils acidifying?



- Acidification is a natural process
- Ancient soils naturally acidic (most)
- Accelerated under agricultural production
 - 'broken' nitrogen and carbon cycles
 - Leaching of nitrate
 - Removal of produce



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