# Combating Acid Soils

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RURAL SOLUTIONS SA
PIRSA

Tungkillo Landcare Group

Government of South Australia

Natural Resources SA Murray-Darling Basin

Natural Resources Adelaide and Mt Lofty Ranges

Government of South Australia

Agricultural Bureau of South Australia Inc.
PATHWAY TO IMPROVEMENT

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National Landcare Programme

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# Contents

- Understanding soil acidity basics
- Local data and trends
- Recent acidity work including lime comparison trials and precision pH mapping
- Lime sources MLR
- Tool and models

# What are the Critical pHCa levels?

- < pHCa 5.5- acidity getting in the zone
- < pHCa 5.2 – very sensitive crops begin to be affected, sensitive microbes and rhizobium effected
- < pHCa 5.0- acidity starts to creep into subsurface layers and Mn released in some soils
- < pHCa 4.8 – significant Al release in most soils, most legumes nodulation affected
- < pHCa 4.5 – tolerant crops affected
- < pHCa 4.0- irreversible degradation of clay and release of Fe

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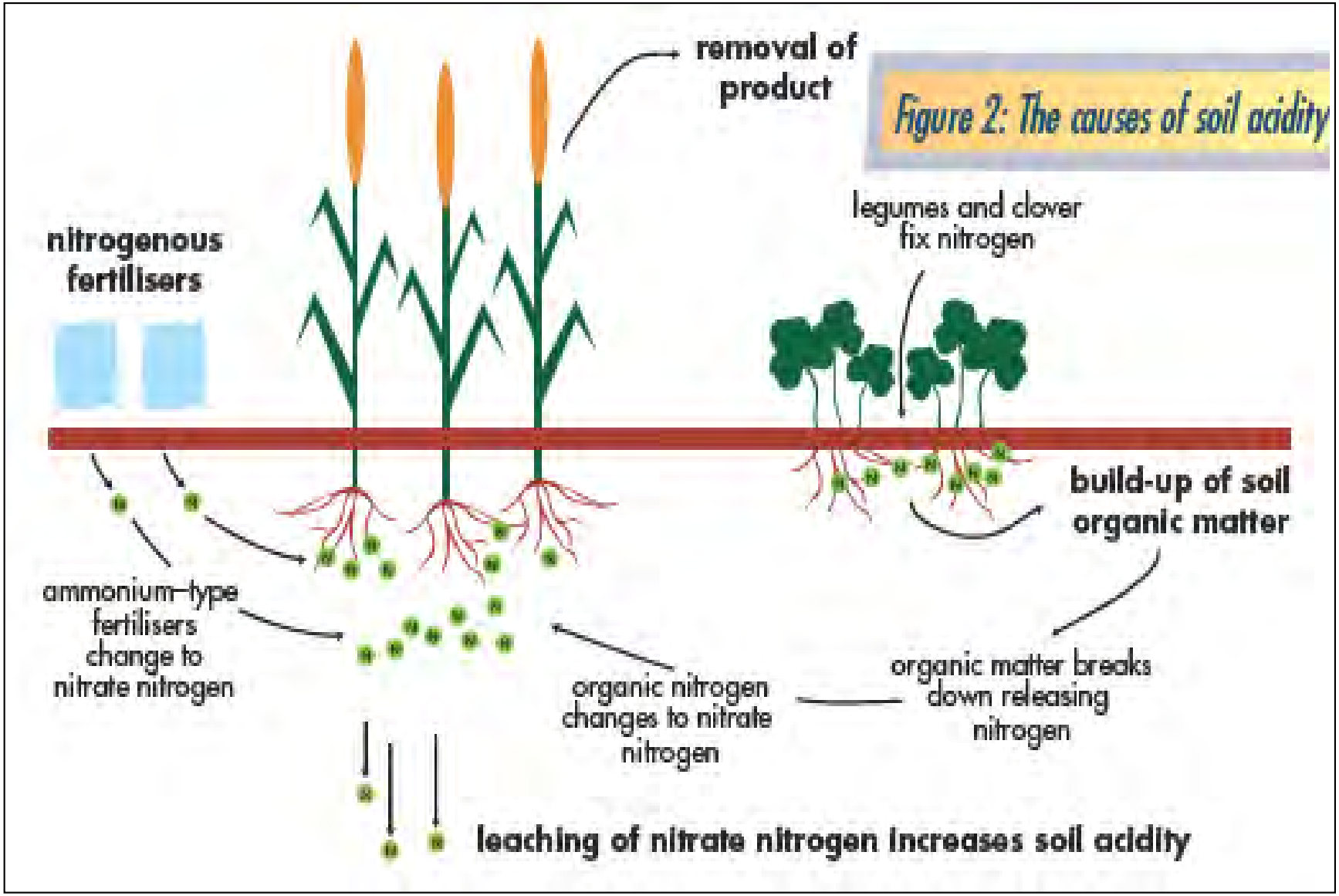
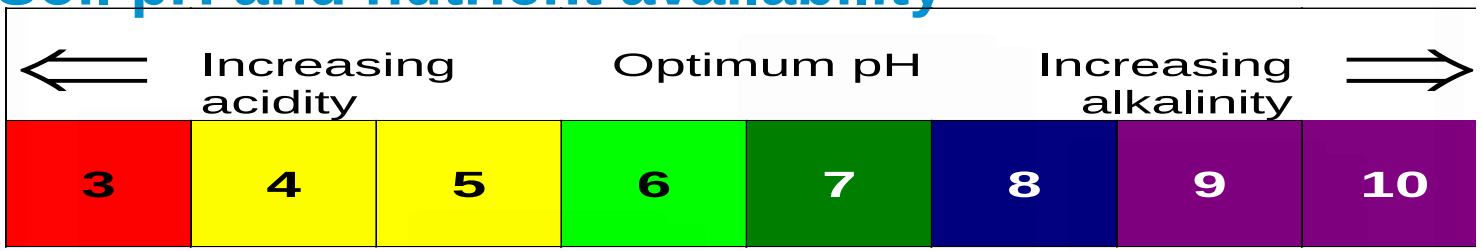
# Causes of acidification



# SOIL ACIDITY IMPACTS-
# Soil pH and nutrient availability




**TOO MUCH:**

•aluminium

•manganese

•Iron

**NOT ENOUGH**:

•magnesium

•calcium

•potassium

•phosphorous

•molybdenum

**TOO MUCH:**

•sodium

•Boron

**NOT ENOUGH:**

•iron

•zinc

•manganese

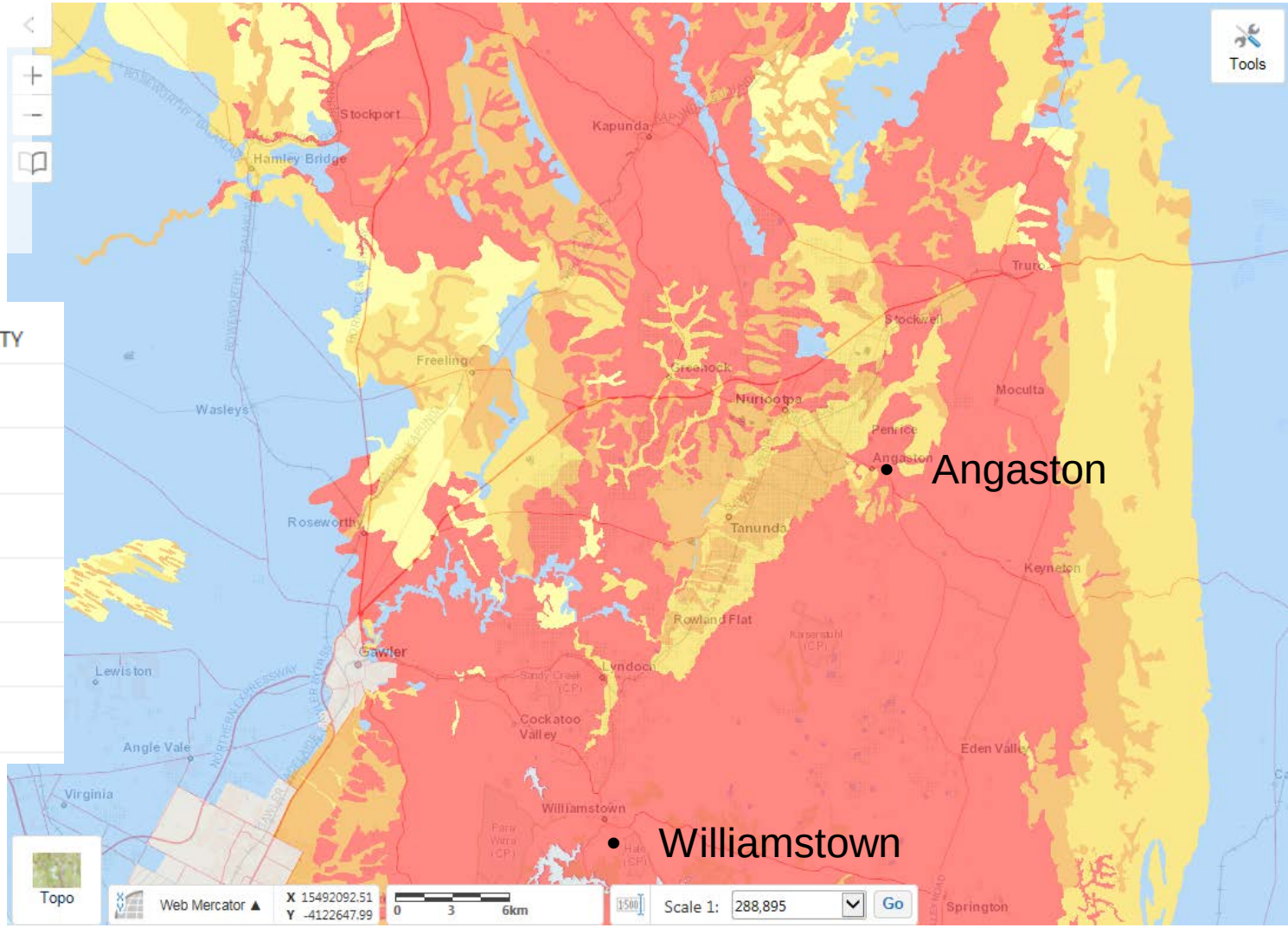
•copper

•phosphorous

# Acid Prone areas BIGG

EXTENT SURFACE ACIDITY

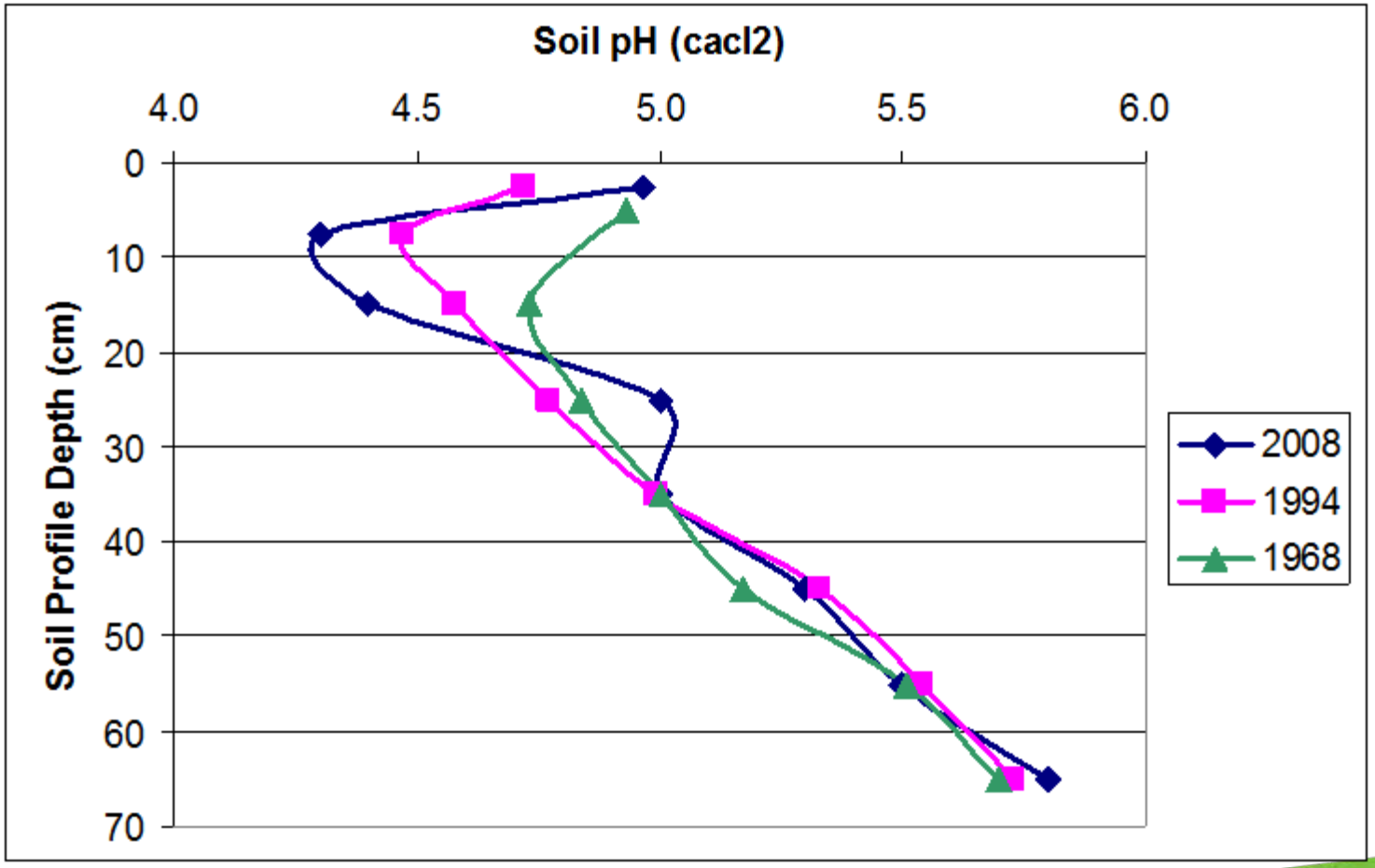
- Negligible
- Less than 10%
- 10-30%
- 30-60%
- >60%
- Not applicable



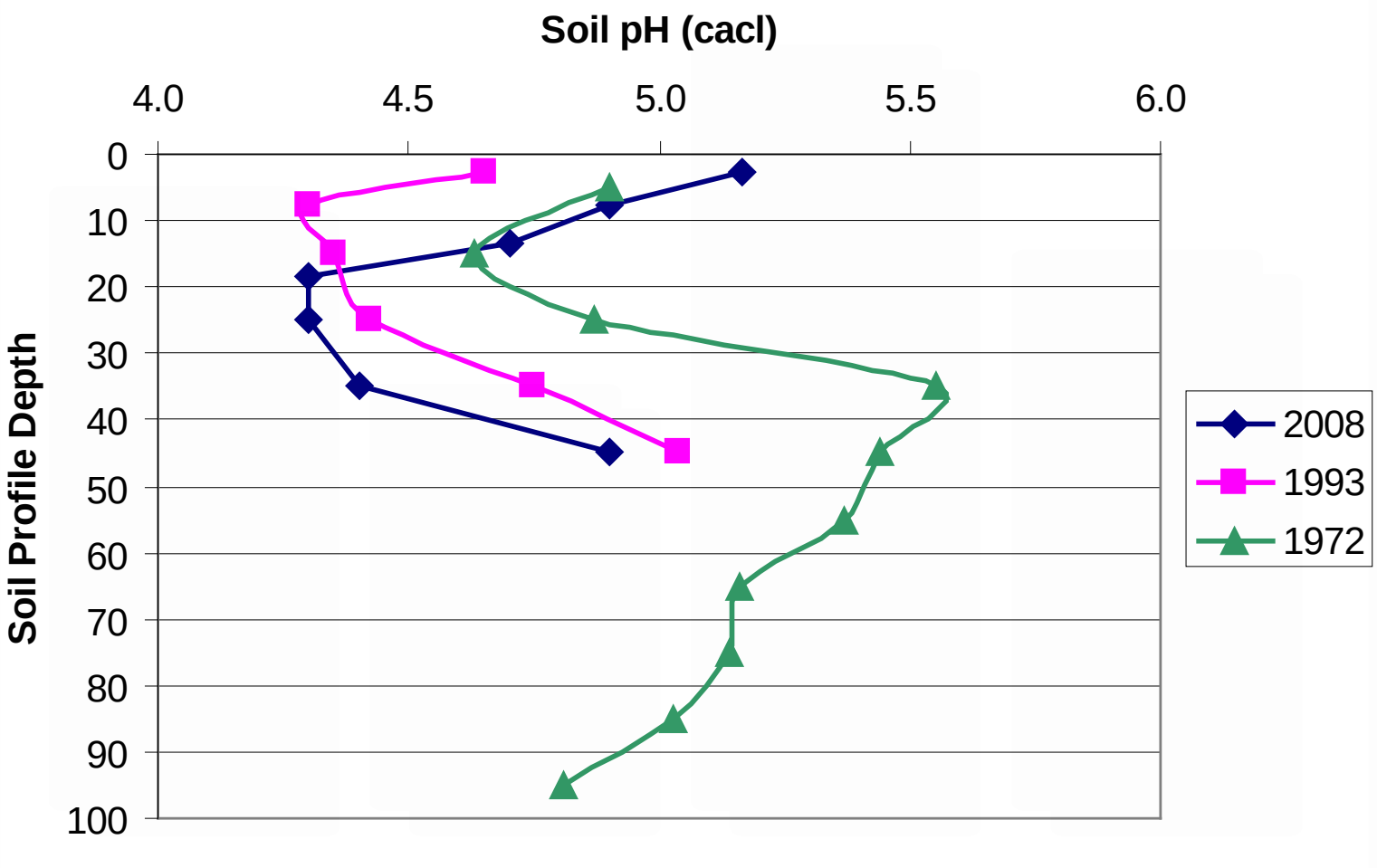
# Rates of Acidification - mostly from 70s to 90s from Merry, CSIRO

| Land Use | Mean Annual Acidification Rate Kg lime/ha/yr |
|---|---|
| Low Intensity Grazing | 30 |
| Medium Intensity Grazing- some hay cuts | 100 |
| High Intensity Grazing, regular hay, silage | 150 |
| Cropping Pasture Rotation | 100 |
| Intensive Cropping- some pasture, high N inputs | 200 |
| Mostly continuous Cropping- high N inputs | 250 |
| **Continuous cropping- high N, high rainfall, leaching years** | 350 ?? |
| **High N grassy pasture systems** | ?? |

# Examples in the MLR
# No lime, still acidifying



# Examples in the MLR
# One application of 2.5 t/ha



# SOIL pH data- BIGG area

| | | pHCa | | | |
|---|---|---|---|---|---|
| Data Source | no. | <4.5 | 4.5-5.0 | 5.0-5.5 | >5.5 |
| BIGG dairy | 74 | 12% | 28% | 26% | 33% |
| BIGG improved pasture | 6 | 66% | 17% | 17% | |
| BIGG native pasture | 20 | 0 | 15% | 20% | 65% |
| | | <4.7 | 4.7-5.1 | 5.2-5.4 | >5.4 |
| S Ellis MLR 2013 # | 219 | 22% | 44% | 14% | 20% |

acknowledge data from G Keynes, B Hancock

#Northern break up slightly better pH although includes some BV sites

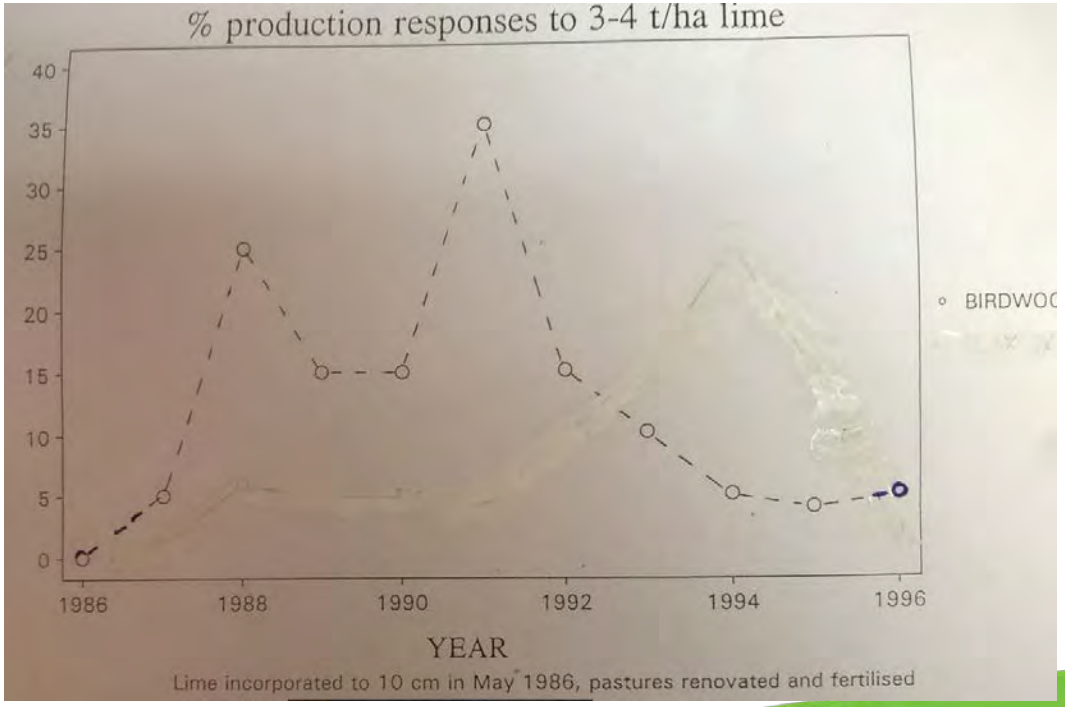
Lacking information on subsoil or subsurface acidity

# SOIL ACIDITY AND MANAGEMENT – SUMMARY OF RESPONSES IN CROPPING/LIVESTOCK TO LIME

- Large responses in cropping - up to 40% in some trials
- Particularly in sensitive species such as canola, barley and intolerant varieties of wheat
- Good responses in livestock - up to 30% increases in livestock weight

# Mt Lofty Ranges – Birdwood Historic Site

| Sites | Soil | pHCa | Al – Ca Cl2 |
|---|---|---|---|
| Birdwood | FSL/ brown clay | 4.3 | 2.8 |




Visual responses were still evident in 2001 on high lime plots (15 years after)

Responses mostly using clover/ ryegrass pastures which are considered tolerant of acid soils.

# Current Activities- partners include GRDC, DEWNR, AMLR and MDB NRMBs, PIRSA

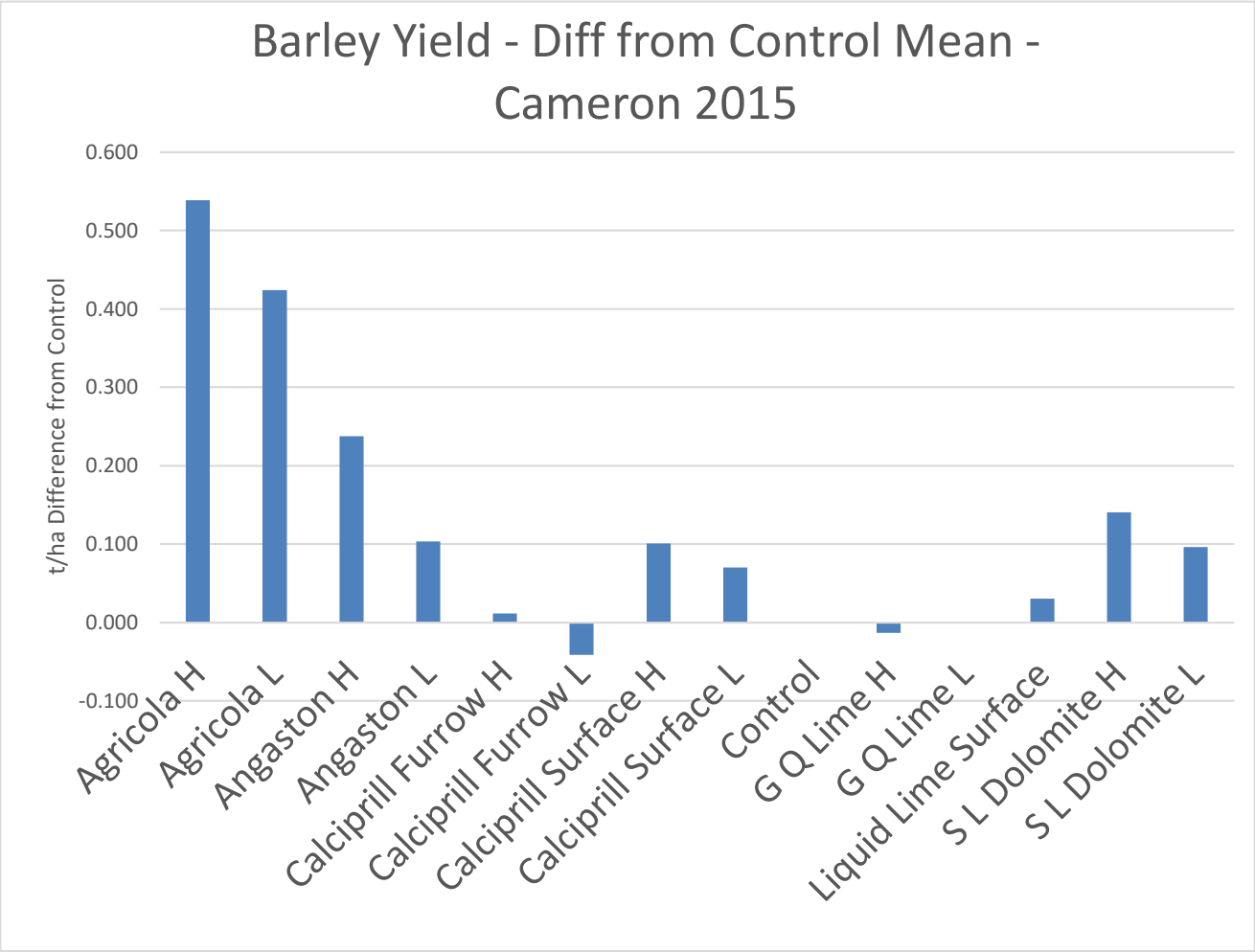
- Trials looking at new products, subsoil issues

**Tungkillo Trials (2014-17)**

**Camerons cropping**
**Barstch low input pasture**

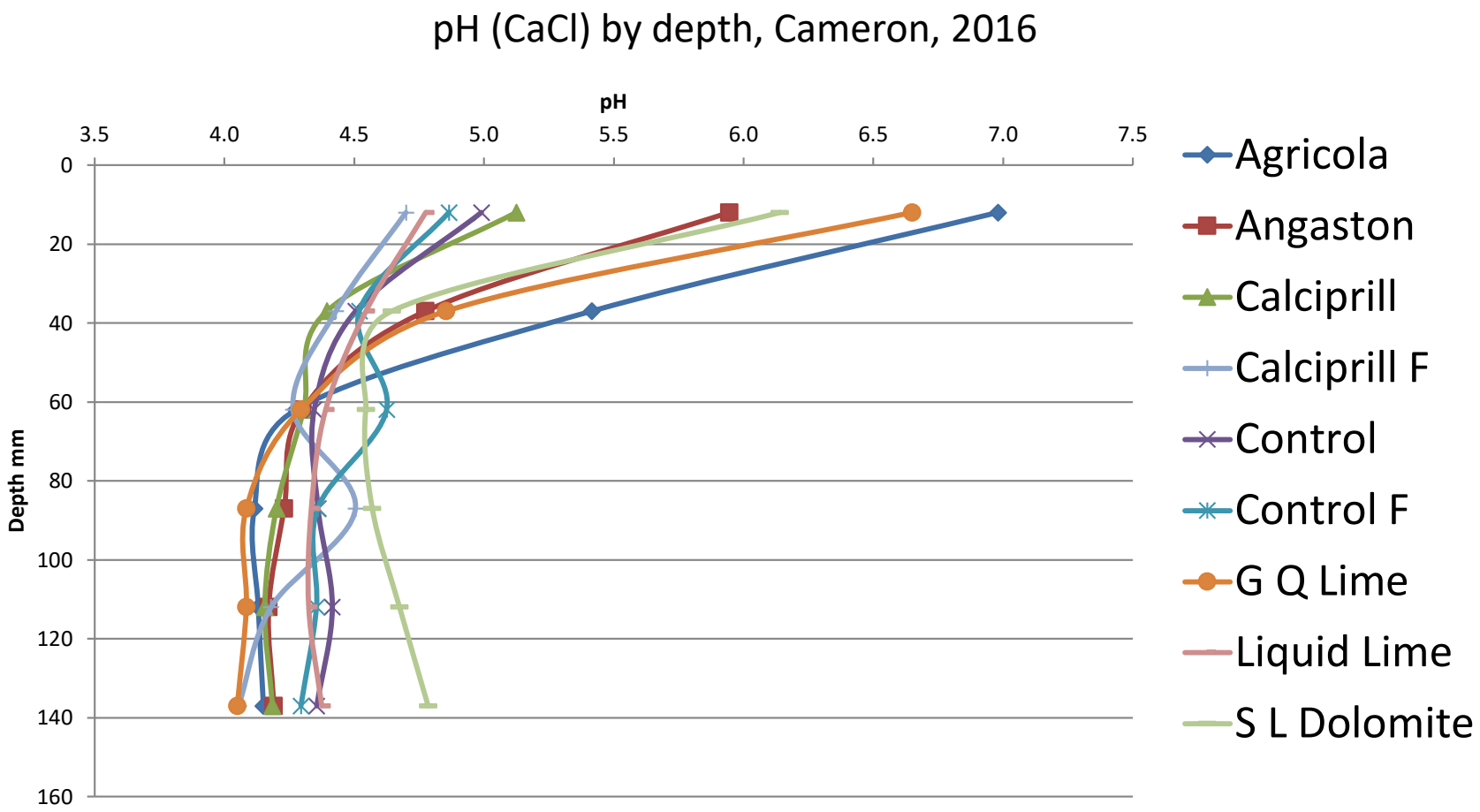
*Agricola*
*Angaston*
*Southern Lime Dolomite*
*Goolwa Hartley Quarry*
*Calciprill- incorporated*
*Liquid Lime*

# Tungkillo Landcare Group cropping trial- 2 years after lime applied, no till

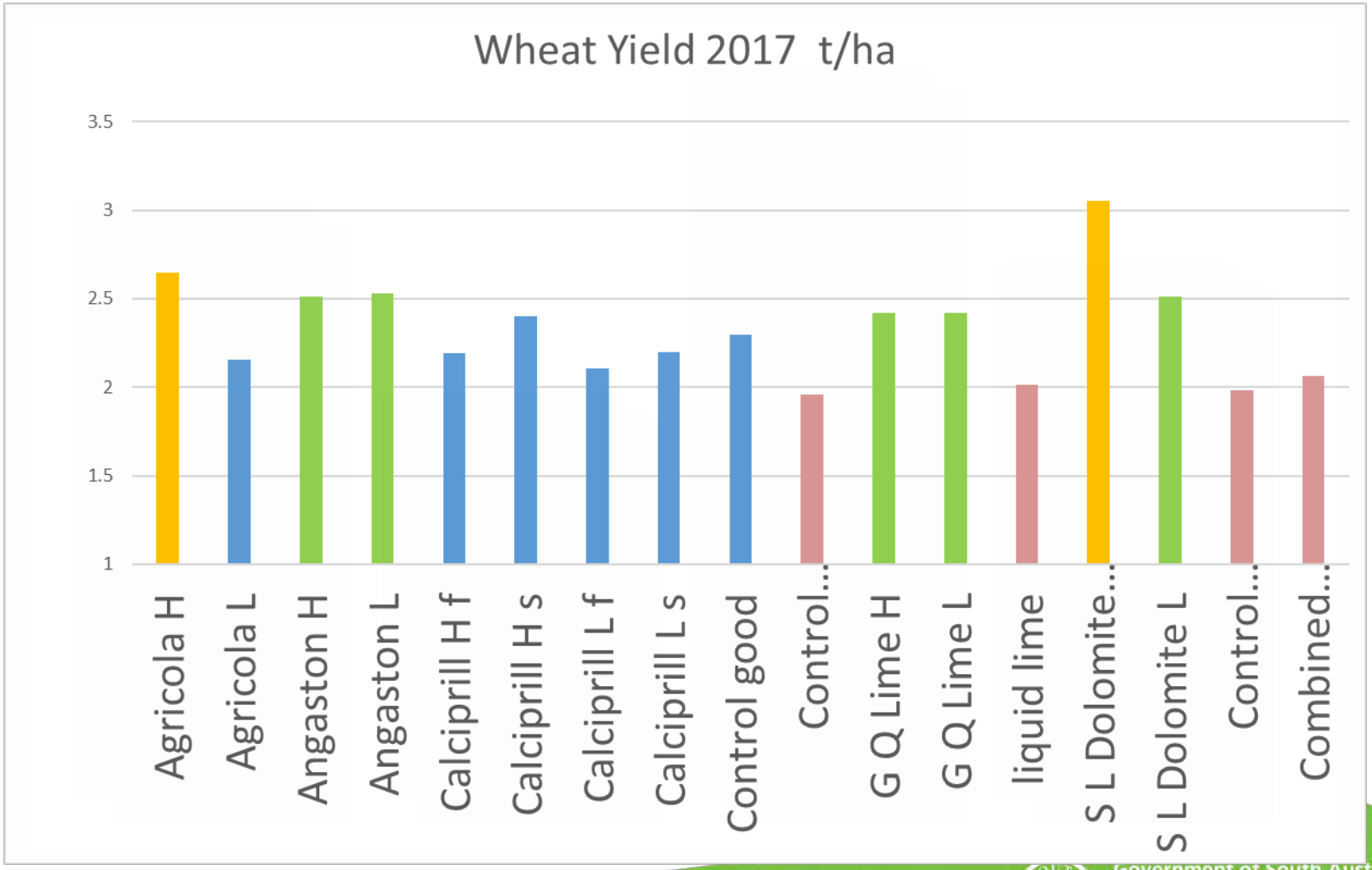



The results showed a significant effect of treatment (P= 0.034) on yield.
Minimum non-zero LSD was 0.2 t/ha

# Tungkillo pH by depth effect

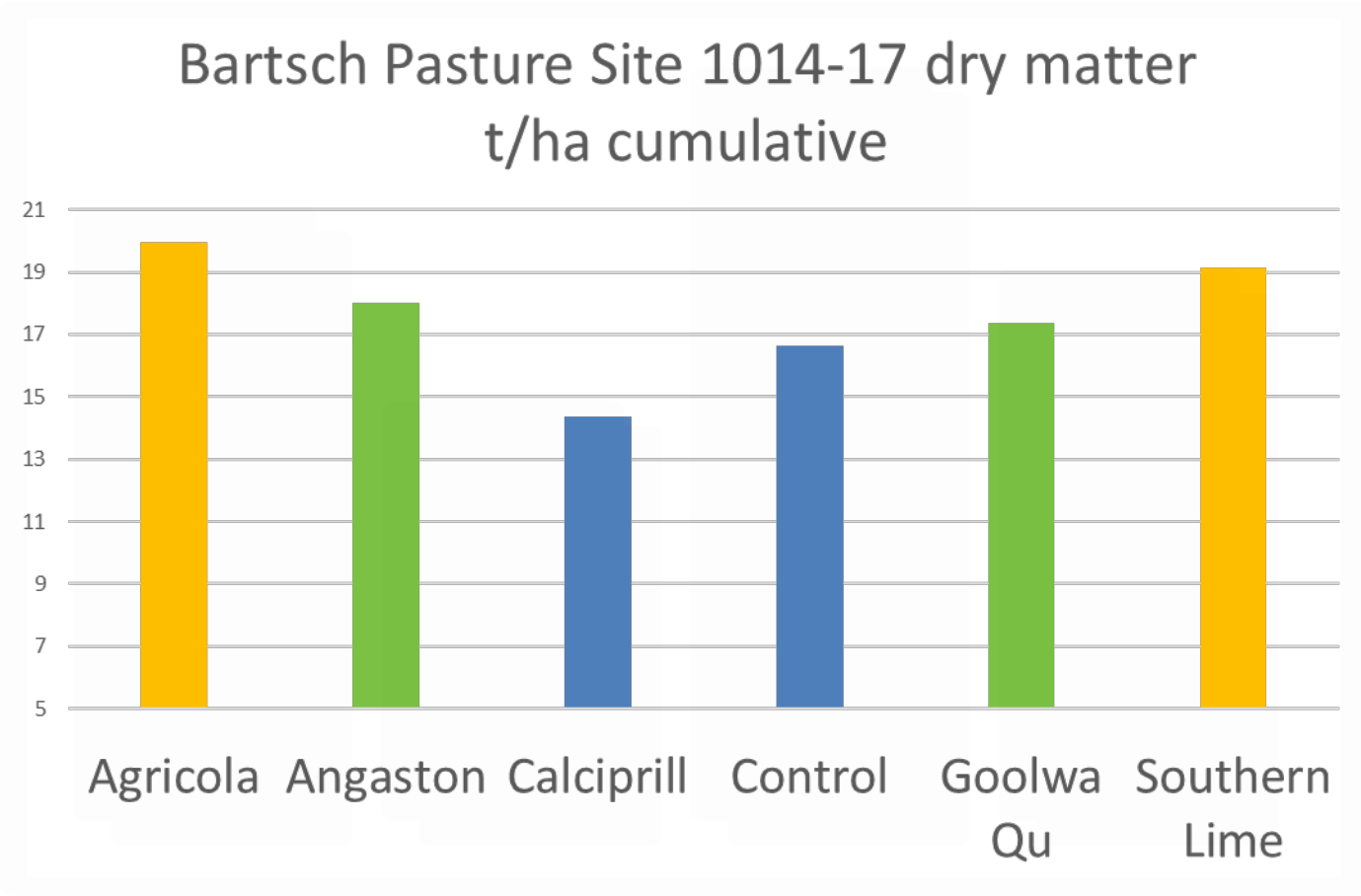


# Tungkillo Landcare Group cropping trial- 4 years after lime applied- better quality limes and higher rates best response

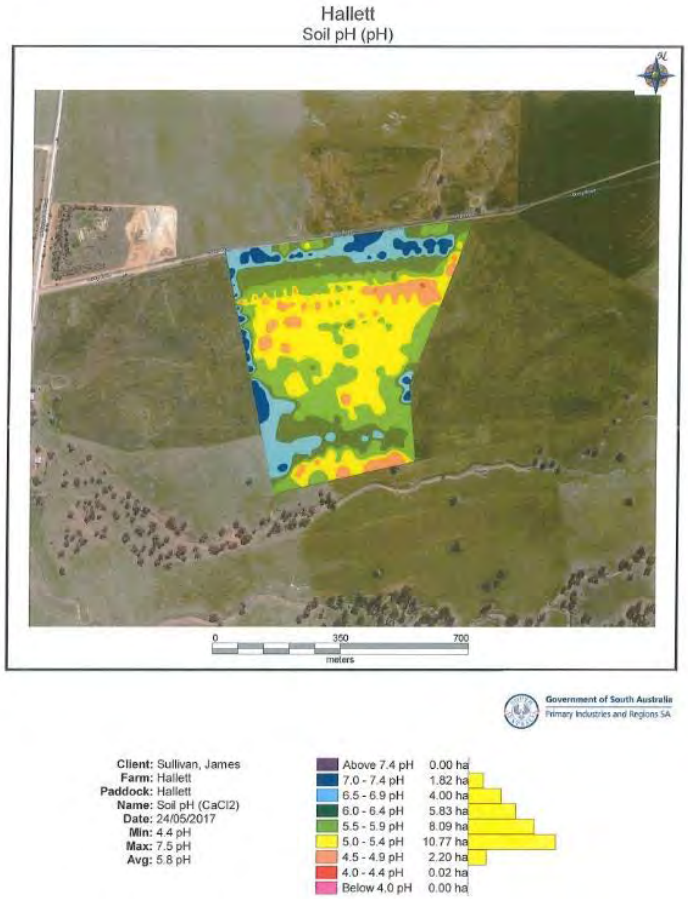


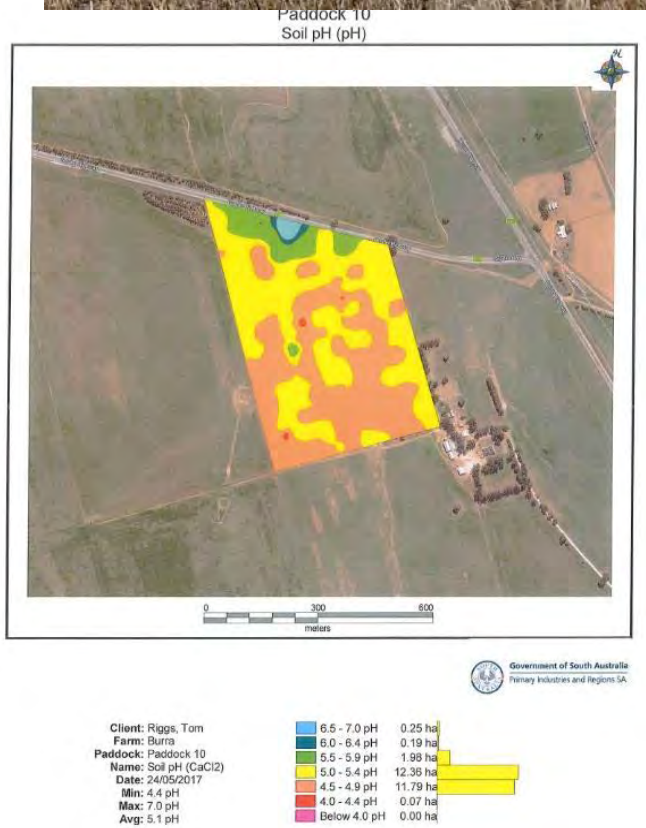
Tungkillo Landcare Group lime comparison pasture trial

- low intensity grazing paddock- lime @3 t/ha surface applied
- Result around 5 ton increase/4 year



# Evaluating Precision pH mapping



# Understanding Lime Quality

- Neutralising value NV measures purity- $CaCO_3$ equivalent

- Effective Neutralising value ENV- measures fineness (<300micron, 300-850, > 850) does not work with all SA limes

- Other lime quality measures
  - surface area
  - RH value

- Calcium and Magnesium content

# MLR Lime Sources – from Tungkillo trial +

| Source | NV % | ENV % | Ca % | Mg % | Comment |
|---|---|---|---|---|---|
| AB Angaston coarse | 92 | 39 | 36 | 0.5 | Coarse product |
| AB Angaston Penlime | 97 | 90 | 38 | 0.5 | New finer product |
| AB SL Dolomite | 88-95 | 79-94 | 24-32 | 4-7 | Fine to handle |
| GQ Hartley | 81 | 35 | 22 | 6 | Coarser to handle |
| Cawtes | 87 | 69 | 31 | 2 | High surface area |
| Agricola Robe | 85 | 41 dry, 82 wet | 26 | 5 | Dispersive lime not suited to ENV, high surface area |
| Clare Q (Spalding) | 65 | 64 | 24 | 1 | Low NV but v fine |
| Kruse/Nutrilime | 98-120 | 38-77 | 39 | 0.4 | Not suited ENV, contains other forms inc CaOH |
| Calciprill | 93 | 9 | 36 | 0.7 | Granular form not suited to ENV |

# How much Lime is Required: Simple Equation

- **Accurate soil pH test required**

- **Soil texture factor**

Lime (t/ha) required to raise pH by one unit: ( assumes 100% NV)

| | | |
|---|---|---|
| sand | 2 | (1.5 -2.5) |
| sandy loam | 3 | (2.5 – 4.0) |
| loam | 4 | (4.0 – 5.0) |
| clay | 5 | (4.0 – 6.0) |

- **Lime application rate =(Target pH - Current pH) x Texture factor**

Example for a Sandy loam soil: (pH 5.5 – pH 4.5) x 3 t/ha
= 3 t/ha of lime required.

# Treating soil acidity – decision support tools
## (Acid Maths Made Easy)!

Computer software programs are available to help calculate:

- Lime application rates for acidic soils & cost comparisons of different lime products

**Lime Cheque**

- Soil acidification rates of cropping systems and lime required to counteract it

**Maintenance Lime Rate Calculator**

- Cost of production losses to the farm business from soil acidity

**ACID$COST**

All three tools are Excel Spreadsheets, enabling input of own soil type, pH, and paddock data.

They are free and downloadable from:

website: https://agex.org.au/project/soil-acidity/ under "decision support tools"

# Acidity Tools Lime Comparison

## Lime Sources Comparison

| | Source 1 | | Source 2 | | Source 3 | | Source 4 | |
|---|---|---|---|---|---|---|---|---|
| Source | Brenton Kruze | | Kulpara | | Penrice | | Clare quarry | |
| Lime Cost $/t | $40.00 | | $16.00 | | $35.00 | | $10.91 | |
| NV or ENV % | 100 | | 94 | | 98 | | 55 | |
| Tonnes required | 300 | | 319 | | 306 | | 545 | |
| Distance from source | 46 | km | 89 | km | 72 | km | 60 | km |
| Freight cost | 0.18 | $/km/t | 0.18 | $/km/t | 0.18 | $/km/t | 0.18 | $/km/t |
| | $8.28 | $/t | $16.02 | $/t | $12.96 | $/t | $10.80 | $/t |
| Spreading cost | $12.00 | $/ha | $12.00 | $/ha | $12.00 | $/ha | $12.00 | $/ha |
| Contract F&S cost | | $/t | | $/t | | $/t | | $/t |
| Total $/t | $52.28 | | $35.78 | | $51.88 | | $23.91 | |

| Product rate & cost | Rate t/ha | Cost $/ha | Rate t/ha | Cost $/ha | Rate t/ha | Cost $/ha | Rate t/ha | Cost $/ha |
|---|---|---|---|---|---|---|---|---|
| Zone 1 | 3.0 | $157 | 3.2 | $114 | 3.1 | $159 | 5.5 | $130 |
| Zone 2 | | | | | | | | |
| Zone 3 | | | | | | | | |
| Zone 4 | | | | | | | | |
| Paddock | | $157 | | $114 | | $159 | | $130 |
| Cost per paddock | $15,684 | | $11,419 | | $15,882 | | $13,042 | |
| Quantity of lime t | 300 | | 319 | | 306 | | 545 | |

# Take Home Messages

- Soil acidity still developing with higher rates in more intensive farming
- Most of the BIGG area is acid prone
- Soil testing data indicates a significant number of soil tests below 5.0, more information is required on subsurface pH
- Recent trials have confirmed lime responses in cropping and low input pasture with better quality limes still in front after 4 years
- Precision pH mapping is well suited to cropping soils but has some issues on long term pasture
- Various excel spreadsheets tools are available to compare the cost of limes or audit farming systems for acidity

# Thank You to Project Sponsors/ partners

- Acknowledge A Harding, M Young, B Masters PIRSA

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