



# South West Soil Acidity Research

Southern Farming Systems

17/10/2016



**Craig Drum** @drum\_craig · Oct 12

@SouthernFS Lisa miller talking lime quality and yield response from lime. Old topic but obviously still very relevant



Worldwide Trend

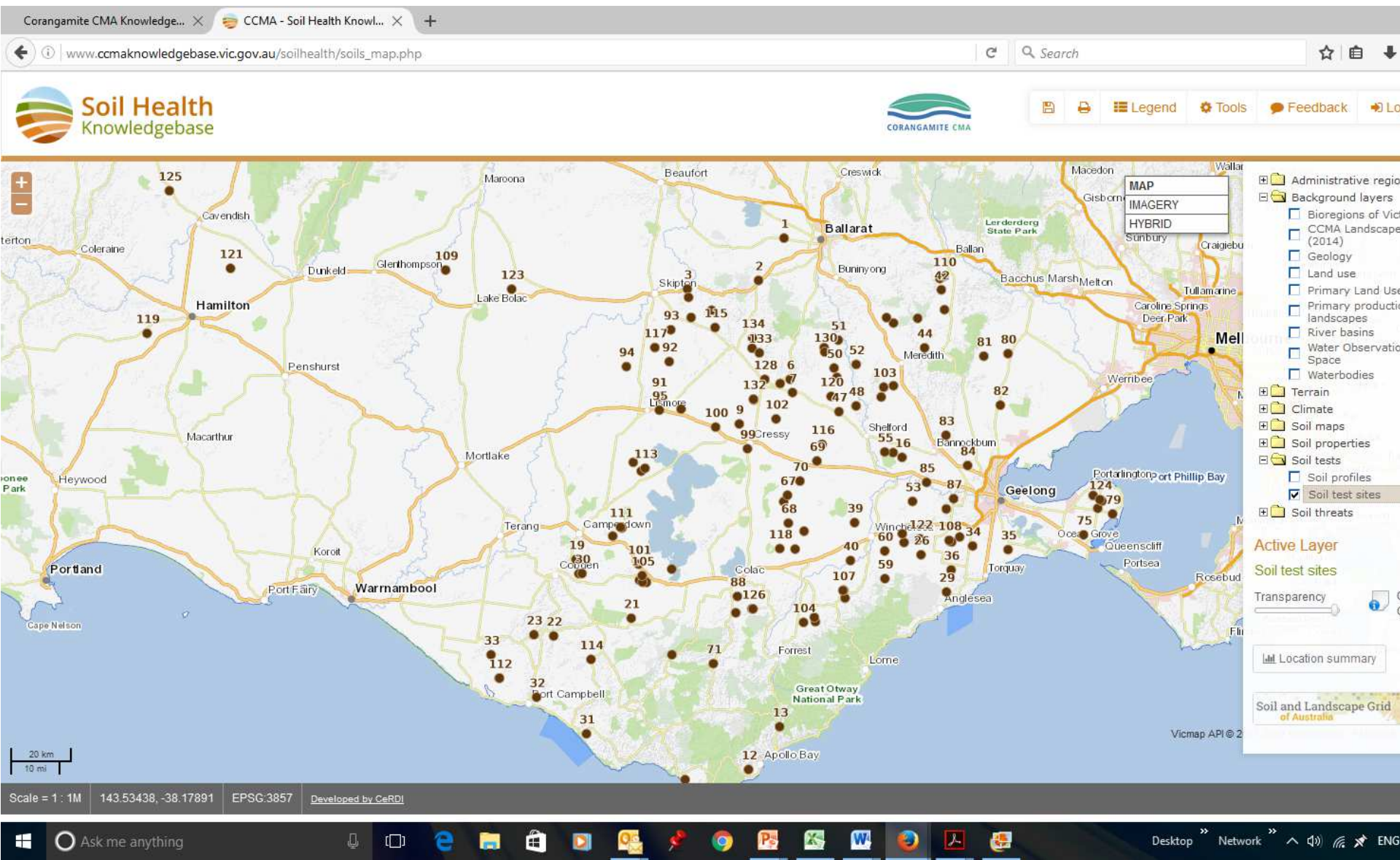
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# Research

- What acidity issues do we have and in what soils?
- What are the benefits and costs of applying lime in crops and pastures to ameliorate soil acidity?
- How much and how often does lime need to be applied?
- Is lime addressing soil acidity at depth?
- What tests best indicate lime effectiveness?



# Soil pH monitoring paddocks & trial sites to measure acidification rates





A photograph of a soil profile. At the top, there is a layer of green grass. Below the grass is a dark brown, crumbly topsoil layer. Underneath that is a lighter brown, more compact layer. At the bottom is a thick, yellowish-brown layer with visible horizontal striations, likely from a plow. A vertical line of small, white, reflective markers is placed in the soil, extending from the surface down into the yellowish layer. To the right of this line, text is overlaid on the image, providing pH values for different depths.

Soil pH(Ca)

0-10 cm 6.6

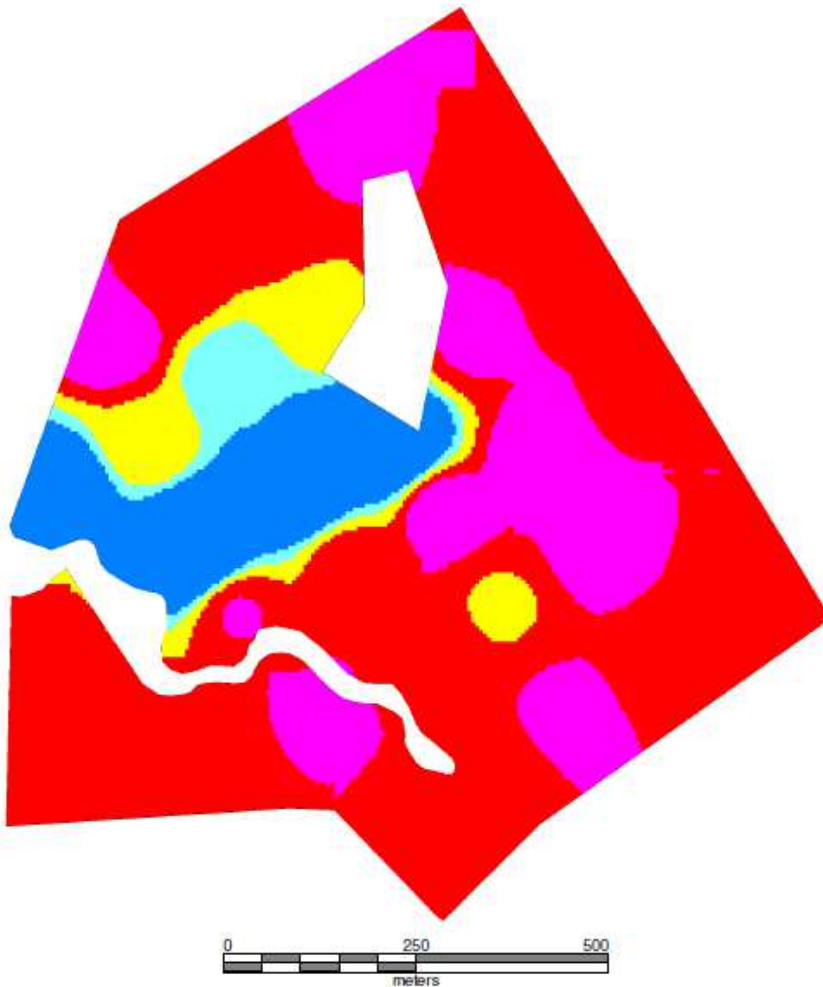
10-25 cm 4.5

25- 35 cm 5.1

35- 70 cm 7.0



Areas within  
paddocks can be  
highly acidic &  
unidentified from  
taking a bulk soil  
sample eg paddock  
soil pH 5.1



Client: Bingley, Tim  
Farm: The Meadows  
Paddock: South  
Name: pH & P Map June 2016  
Min: 4.3 pH  
Max: 7.0 pH  
Avg: 4.8 pH

5.6 - 7.0 pH	8.18 ha	
5.2 - 5.5 pH	2.71 ha	
4.8 - 5.1 pH	4.86 ha	
4.5 - 4.7 pH	41.03 ha	
4.3 - 4.4 pH	15.76 ha	

THE

# Summary of SW crop trials using surface applied lime 2.5 to 3 t/ha

Trial Location	2012	2013	2014	2015	2016	pH (Ca) 0-10 cm	Al (Ex)	Organic Carbon %
Bellarine			Barley	Canola		4.2	17%	2.2%
Shelford				F. bean		4.9	0.4%	3.9%
Modewarre			Wheat	Barley		4.6	1.4%	3.9%
Warncoort			Hay	Canola		4.5	2.1%	3.9%
Rokewood west		F. Bean	Canola	Wheat		4.8	3.0%	2.4%
Rokewood North	Canola*	Wheat	Wheat	F. Bean		4.5	5.5%	2.0%
Werneth	Canola	Wheat	F.Bean	Wheat		4.7	2.3%	2.4%
Cape Clear	Canola	Wheat	Wheat	Wheat		4.9	1.2%	3.2%
Mingay			Barley	Barley		4.8	1.8%	2.8%
Westmere			Wheat	Barley		4.3	3.9%	2.3%
Gatum			Canola	Wheat		4.4	12.8%	4.1%
Yulecart			Canola	Barley	Balansa	4.5	9.2%	4.9%
Hensley Park			Wheat	Hay		4.4	7.7%	3.2%

Significant P=0.05 or \*0.1

# Summary of crop yield responses to lime in SW trials.

Trial	Crop	No Lime Mean Yield (t/ha)	Lime Mean Yield (t/ha)	Estimated losses of soil acidity
Bellarine	Barley 2014	2.1	3.4	\$361/ha
	Canola 2015	1.3	1.7	\$228/ha
Rokewood Nth	Canola 2013	1.7	2.2	\$256/ha
	Faba bean 2015	0.9	1.3	\$170/ha
Westmere	Barley 2015	1.3	1.9	\$146/ha
Yulecart	Balansa/subclover	1.6	2.3	\$200/ha



# Good pH change in top 5 cm after 2 years but not in 5-10 cm

Soil pH (Ca) change at depth at different crop trial sites

Depth	Modewarre		Shelford		Westmere		Yulecart		Bellarine	
	Nil	Lime 2.5 t/ha	Nil	Lime 2.5 t/ha	Nil	Lime 2.5 t/ha	Nil	Lime 2.5 t/ha	Nil	Lime 3.0 t/ha
<b>0- 5 cm</b>	4.7	5.1	5.0	5.4	4.5	6.3	4.6	5.0	4.2	5.4
<b>5-10 cm</b>	4.4	4.5	5.1	5.3	4.2	4.4	4.4	4.4	4.1	4.4
<b>10-15 cm</b>	4.5	4.5	5.6	5.7	4.4	4.5	4.6	4.6	4.3	4.4
<b>15-20 cm</b>	4.7	4.7	5.9	6.0	4.9	4.8	5.0	5.0	4.5	4.7
<b>0-10 cm</b>	4.6	4.8	5.0	5.4	4.5	5.2	4.6	4.8	4.2	4.9



Incorporating lime –  
Is it cost effective ?





# Testing lime quality

To find out what information growers need to make good liming decisions



# SA soft lime (id 4) fraction sizes and Neutralising Values (NV)

Fractions	Percentage in Dry Sieve Fraction (%)	Dry Sieve NV%	Percentage in Wet sieve Fraction (%)	Wet Sieve NV%	NV from bulk sample
> 5 mm	1.30	83.44	0.23	80.08	
2- 5 mm	19.15	80.71	6.80	82.51	
1-2 mm	19.11	79.66	5.29	85.28	
0.85-1 mm	3.29	78.08	0.76	82.68	
0.3-0.85 mm	20.54	78.85	5.96	84.33	
0.125-0.3 mm	14.20	79.71	5.86	81.54	
0.075-0.125 mm	9.16	80.79	4.76	84.88	
<0.075 mm	13.25	79.27	70.33	76.90	
NV		80%		79%	77%



# NV tests of limes

- not much difference in tests

Test Number	Description	Neutralising Value %		
		Dry sieve - standard bulk sample	Dry Sieve as a proportion of each fraction size	Wet Sieve as a proportion of fraction size
1	GIP Hard Lime	91	94	92
2	SA Dolomite	67	70	67
7D	SA Dolomite	78	81	77
3	SA Soft Lime	92	95	92
4	SA Soft Lime	77	80	79
9	SW Soft Lime	84	84	87
10	SW Soft Lime	78	78	81
11	SW Soft Lime	84	86	87
12	SW Soft Lime	90	92	93
13	SW Soft Lime	83	84	84

# Dry sieving versus wet sieving results for < 0.3 mm

Lime Id	Dry Sieve 0.125-0.3 mm	Wet Sieve	Dry Sieve 0.075-0.125mm	Wet Sieve	Dry Sieve <0.075 mm	Wet Sieve
1 GIP Hard Lime	34.32	19.66	4.18	3.09	0.70	16.88
2 SA Dolomite	50.35	49.75	11.55	13.66	6.94	9.41
7 DSA Dolomite	15.42	2.17	7.24	2.82	16.20	79.22
3 SA Soft Lime	28.95	23.72	17.59	12.69	16.68	23.39
4 SA Soft Lime	14.20	5.86	9.16	4.76	13.25	70.33
9 SW Soft Lime	25.12	27.43	8.72	21.11	2.33	26.14
10 SW Soft Lime	13.10	15.14	17.33	26.42	11.05	39.82
11 SW Soft Lime	29.23	29.27	18.90	18.86	7.69	13.20
12 SW Soft Lime	24.86	27.06	6.49	9.73	3.69	26.64
13 SW Soft Lime	33.12	30.27	4.81	4.86	2.46	15.84
Average	26.87	23.03	10.60	11.80	8.10	32.09



# How can I compare limes?

Calculations based on NV multiplied by proportion of different fraction sizes which are discounted by their anticipated reactivity or effectiveness at changing pH within the soil

<b>Vic. Effective Neutralising Value (ENV) calculation</b>	<b>NSW DPI Lime comparison spreadsheet, 2003</b>	<b>Soil Quality Online Lime Comparison Calculator</b>
< 0.3 mm = 100% 0.3 to 0.85 mm = 60% >0.85 mm = 10%	< 0.075 mm = 100% 0.075 to 0.15 mm = 58% 0.15 to 0.25 mm = 42% 0.5 to 1 mm = 34% 1 to 2 mm = 22% > 2 mm = 12%	<0.125 mm =100% 0.125 to 0.25 mm =100% 0.25 to 0.5 mm = 100% 0.5 to 1 mm = 50% > 1mm = 20%

# ENV of soft limes generally improved with wet sieving

Test ID	Description	Effective Neutralising Value		
		ENV Standard report (dry sieve sub sample)	ENV dry sieve	ENV Wet Sieve
1	GIP Hard Lime	64	66	64
2	SA Dolomite	52	54	54
7D	SA Dolomite	45	46	70
3	SA Soft Lime	71	74	69
4	SA Soft Lime	41	42	68
9	SW Soft Lime	45	45	70
10	SW Soft Lime	41	41	69
11	SW Soft Lime	54	56	61
12	SW Soft Lime	52	53	69
13	SW Soft Lime	57	57	62

Report Number: 439922

This report supersedes Report Number 439422

CAM NICHOLSON  
32 STEVENS ST  
QUEENSLIFF  
VIC 3225

Report Authorised  
Paul Kennelly  
Laboratory Manager

Wet sieving  
fraction sizes will  
increase testing  
costs.

Sample Number:	030005971	Sample Description:		Date Sampled:	20/03/2014
Test Code:	D1		GEELONG LIME	Date Received:	25/03/2014
Purchase Order No:	C NICHOLSON			Date of Report:	4/04/2014
Grower Name:	CAM NICHOLSON				

\$120-\$160 per  
report depending  
on amount of  
sieved fractions

Analyte	Result	Units	Method Code	Comments
Calcium	32	%	04-073-ICP20	HCl digestion
Magnesium	0.62	%	04-073-ICP20	HCl digestion
Sodium	0.10	%	04-073-ICP20	HCl digestion
Potassium	0.37	%	04-073-ICP20	HCl digestion
Sulfur	0.12	%	04-073-ICP20	HCl digestion
Moisture Content	7.5	%	04-072-RAW_MOIST	Water loss at 40°C
Material > 5mm	0.5	%	04-071-RPSA	Particle Size Analysis
Material 2.00mm - 5.00mm	3.4	%	04-071-RPSA	Particle Size Analysis
Material 1.00mm - 2.00mm	8.7	%	04-071-RPSA	Particle Size Analysis
Material 0.85mm - 1.00mm	2.9	%	04-071-RPSA	Particle Size Analysis
Material 0.30mm - 0.85mm	40.7	%	04-071-RPSA	Particle Size Analysis
Material 0.075mm - 0.30mm	38.7	%	04-071-RPSA	Particle Size Analysis
Material < 0.075mm	5.1	%	04-071-RPSA	Particle Size Analysis
Neutralizing Value	90	%	04-054-WCALC	
Effective Neutralizing Value	62.79	%	04-054-WCALC	

The results pertain only to the sample submitted.  
This document shall not be reproduced except in full.  
Sample material is dried at 40°C and ground before chemical analysis.



# Using ENV to adjust lime rates and compare paddock costs

Lime Test Number	Costs per tonne	Cost spread per tonne of lime	ENV wet sieve	Adjusted lime rate for ENV	Lime required to treat paddock	Paddock cost
	\$/t	\$/t	%	t/ha	t/paddock	\$/paddock
9	\$26.00	\$40.31	70	3.41	196	\$7,893.74
10	\$18.00	\$32.31	69	3.46	176	\$5,683.08
11	\$18.00	\$28.87	61	3.92	202	\$5,843.05
12	\$22.00	\$36.22	69	3.5	194	\$7,037.03
13	\$28.00	\$44.65	62	3.87	212	\$9,461.25

Lime rate 2.4 t/ha

Adjusted lime rate for ENV =  $2.4 * 100 / \text{ENV}$

# Key messages

- Farming acidifies soil, so lime is a necessary management input.
- Soil acidity varies across paddocks and within the soil profile and test soils or pH map to identify these areas.
- Acidic areas,  $< \text{pH}(\text{Ca}) 5.0$  will be losing potential production.
- Liming acidic soils when  $\text{pH} < 5.0$  is cost effective.
- Limes vary in quality and so base decisions on test information which includes tests which determine the fineness of the lime using wet sieving.
- When costing limes, adjust the rate of lime for its NV, fineness or ENV to account for how reactive the lime is.