

Project LIE 00008

**Working together to deliver multiple benefit
messages to growers through a whole systems
approach to soil management**

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Introduction

Soil acidity has long been recognized as a serious limitation to agricultural production in Western Australia. As a consequence, there has been considerable investment from both the government and private sector in establishing lime trials and demonstrations to show the value of managing soil acidity appropriately.

The Department of Agriculture and Food WA has been a key player in establishing many trials that have been aimed to service both field based research and subsequent extension opportunities. Unlike other agronomic trials, lime trials remain valuable (if relocatable) for many years post their establishment phase.

Obtaining the best extension value from lime trials is always a challenge compared to other field based agronomy. The reasons are complex, but some key issues are:

- The time lag, some trials can take several years to respond and/or 'become visual' can complicate 'extension' opportunities
- Establishment of many lime trials happened when grower interest was far less than it is today, hence there may have been a lack of 'receptiveness' to view and absorb information, and this has now changed
- Tenure of funding and focus on lime is not always aligned optimally, hence valuable lime trials are 'abandoned' before they become important and suitable to promote to growers
- Suboptimal rates of lime initially applied to 'ameliorate' acidity adequately, for example when surface acidity is resolved, but subsoil acidity is still limiting.

Ongoing extension of the importance of lime in farming systems is now more topical for farmers and the diversity of industry people that growers work with. GRDC has supported a new approach to enhance extension opportunities- by 'reusing' some old lime trials.

Since this project commenced, Aglime has successfully located many old lime trials across south west of WA. Many have been soil sampled; others will be sampled during the next sampling season.

Forward

With the widespread recognition of extent and severity of soil acidity as a limitation to agriculture in WA, there have been many projects involved in the establishment and subsequent monitoring of the trials and demonstrations of using lime. One of the key extension tools used in the mid 1990's was the establishment of large scale (farmer equipment) demonstration sites to provide a valuable resource for research and serve as a reference point to assess the benefits of liming across WA. Many of these early trials are being relocated, soil sampled, and used for extension purposes now - which is testament to the foresight of those involved in establishing them.

Many people contributed to the establishment and conduct of lime field trials and demonstrations, particularly the Western Australian Soil Acidity Research and Demonstration team:

- Chris Gazey
- Amanda Miller
- Dave Gartner
- Sandy Pate
- Geoff Anderson

Other DAFWA staff also assisted with the process:

- Mike Bolland
- Nancye Gannaway
- Vicki Bolt
- Dan Hester
- Jason Brady
- Andrea Hills
- Jasmine Cheetham
- Colin Holt
- Adrian Cox
- Meg Howe
- Tony Clark
- Kylie Jensen
- Jenny Crisp
- Brendan McAuliffe
- Don Cummings
- Darren Morris
- Eliza Dowling
- Graham Mussell
- Amanda Just
- Tim Wiley

For early data relating to some the trials reported in this document, the reader is directed to:

Penny, S. and Gazey, G (2002) Western Australia Soil Acidity. Demonstration Site Results 1996-2001. Department of Agriculture **Misc Publication 24/2001. ISSN 1326-4168**

Acknowledgements

The 'Time to Lime' project was a major coordinated research and extension initiative during which time, many of the trials reported upon were initiated, and many organisations contributed:

- Grains Research and Development Corporation
- Department of Agriculture, Government of Western Australia
- National Landcare Program
- Land and Water Resources Research and Development Corporation
- National Heritage Trust
- CSIRO Australia
- Centre for Legumes in Mediterranean Agriculture
- The University of Western Australia
- Australia Fertiliser Services Association

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Special thanks to Chris Gazey (Senior Research Officer, DAFWA Northam) and David Gartner for the detailed records kept from the trial establishment phase, and their subsequent assistance in locating this series of field trials.

Methodology

Aglime of Australia has been engaged as the sub-contractor involved in relocating, and resampling these old lime trials. The data reported, and the individual comments made on each trial are delivered in good faith, but should not necessarily be used in isolation in delivering widespread extension messages.

This document contains the five trial reports, and represents the summary of data collected during the project and has been reported against the initial treatments as described by DAFWA (the trial initiator). In some cases, there have been subsequent treatments (ie additional lime) applied to the original trial design. DAFWA is still looking at the full array of additional treatments (for example, combinations of additional lime and tillage options). All pH measurements reported in this document have been measured in the standard 1:5 soil: 0.01M CaCl₂.

For simplicity only the initial lime treatments and if any subsequent lime has been applied are reported at this juncture.

It is extremely important to clarify that none of the trials reported on, have been under 'scientific management' for many years. Typically the trials reported upon were established, and under a regime of careful management and monitoring typically associated with DAFWA field based research for various times frames (typically for between 3 and 8 years). Since that time, they have all simply remained 'as a zone treated as the rest of the paddock' within the normal farm management regime imposed by the cooperating farmer. In some cases, farms have been sold. Despite concerted attempts, complete understanding of any additional inputs imposed on the trials sites is not known.

Disclaimer

Aglime of Australia, neither DAFWA nor the cooperating farmer has full documentation of all inputs on these sites over that time frame since their establishment. On this basis therefore utmost care must be taken in drawing any isolated conclusions from the data. For instance additional lime, or fertilizer or herbicides could have been dumped on sections of the trial, and this could have influenced soil condition as reported in this document.

Aglime of Australia strongly emphasizes this is preliminary data, and in effect represents 'a photograph in time' in relation to the longevity of time elapsed since the establishment of these field experiments. This is very important, considering the large time lapse involved since trials were established and managed as per the requirements of the researcher involved. In some experiments, known additional treatments have been imposed, albeit typically 2 to 10 years post the initial establishment. Drawing conclusions from either the initial or subsequent treatment applied, and direct attribution of any differences today must be carefully considered.

Aglime of Australia strongly advocates contacting Chris Gazey (Senior Research Officer at DAFWA) Email: chris.gazey@agric.wa.gov.au Mobile 0429 107 976 prior to making any statements about any of the preliminary data reported in this document.

96GE8 – Alan Desmond (now Tim Critch) Mullewa

Key Messages

- There was rapid change in soil pH at this site in the first few years following the establishment of this trial.
- Despite the initial changes in soil pH, there were no positive grain yield responses between 1996-1999.
- In the 2000 wheat crop, there was a negative response to 2t/ha in 2000.
- There has been a dramatic decline in soil pH across all treatments since 2000, despite a total of 4t/ha of lime being applied across the site (two applications of 2t/ha in circa 2009 and 2013).
- The source of the subsequent applications of lime applied by the farmer is unknown

Aim

In the mid 1990's, DAFWA established a series of lime demonstrations sites across the WA wheatbelt, to highlight the importance of managing soil acidity. This trial is one of the series, which had a very simple design (0, 1 and 2t/ha applied, in 3 replicates). The rationale was to use farmer equipment, to enable larger areas to be treated differently, and ultimately provide extension opportunities across the WA wheatbelt.

Background

96GE8 is on a yellow sandplain soil with pre-demonstration topsoil pH of 4.8, and an average subsoil pH of 4.4. Limesand was applied to this demonstration in 1996 post sowing; therefore, the lime was not incorporated. The limesand had a neutralising value of 67%, and a particle size of 93% and was spread at three different rates (0 t/ha, 1 t/ha, and 2 t/ha).

Trial Details

Property:	Tim Critch (previous Alan Desmond), Mullewa
Plot size & replication:	30m wide, 160 m long, area per plot 0.48 ha. 3 treatments by 3 replicates
Soil type:	Sandplain
Soil pH (CaCl₂):	Initially 4.8 (0-10cm) over 4.4 (10-20cm)

Subsequent lime application across the trial

We have been unable to determine if there was any lime application during the period of 1997 to 2008. The current land owner does not believe any lime was applied by the previous land owner during that period

Tim Critch purchased the property from Alan Desmond in 2008. Since that period, Tim has applied 2 applications (both of 2t/ha). Timing of the additional 4t/ha of application and source of quality of lime used unknown. We are assuming both events occurred between 2009 and 2013. We are unsure if Tim applied additional lime across the trial site on either one, or both of the subsequent applications. Further investigation to determine this is in progress.

Selection of initial soil parameters at the beginning of this trial

Soil pH 1996

Lime 2 tonnes/ha	Pre Liming	Mid-Season 96	Change
Average 0-10cm	4.9	5.0	0.1
Average 10-20cm	4.5	4.5	0.0
Average 20-30cm	Not Sampled	5.0	N/A

Lime 1 tonne/ha	Pre Liming	Mid-Season 96	Change
Average 0-10cm	4.7	4.9	0.2
Average 10-20cm	4.5	4.3	-0.1
Average 20-30cm	Not Sampled	5.0	N/A

Lime 0 tonne/ha	Pre Liming	Mid-Season 96	Change
Average 0-10cm	4.7	4.7	0.0
Average 10-20cm	4.3	4.5	0.1
Average 20-30cm	Not Sampled	5.2	N/A

LIME SOURCE USED

LIME SOURCE	NEUTRALISING VALUE	PARTICLE SIZE
Limesand	67%	93%

Soil pH 1997

		Lime rate (t/ha)		
Data	Depth	0	1	2
Average of pH	0-10 cm	5.6	6.2	6.5
	10-20 cm	4.6	5.2	5.8
	20-30 cm	4.4	4.5	4.7

1998 Soil pH:

		Lime rate (t/ha)			
Data	Depth	0	1	2	lsd
Average of pH	0-10 cm	5.1	5.7	6.1	Sig 0.71
	10-20 cm	4.4	4.5	4.6	Sig 0.18
	20-30 cm	5.0	4.7	4.9	NS 0.34

2 t/ha lime applied in 1996 significantly increased soil pH at the 0-10 cm soil depth when sampled in 1998 by 1 pH unit compared to not using lime.

1999 Soil pH:

		Lime rate (t/ha)			
Data	Depth	0	1	2	lsd
Average of pH	0-10 cm	5.1	6.0	6.2	Sig 0.34
	10-20 cm	4.3	4.6	5.0	Sig 0.37
	20-30 cm	4.5	4.8	5.0	Sig 0.23

1 t/ha of lime applied in 1996 significantly increased soil pH at the 0-10 cm, 10-20 cm, and the 20-30 cm soil depths by 0.84, 0.36, and 0.28 pH units respectively compared to not using lime.

2 t/ha of lime applied in 1996 significantly increased soil pH at 0-10 cm, 10-20 cm, and 20-30 cm soil depths by 1.12, 0.7, 0.46 pH units respectively compared to not using lime.

2000 Soil pH:

		Lime rate (t/ha)			
Data	Depth	0	1	2	lsd
Average of pH	0-10 cm	4.9	5.9	6.3	Sig 0.7
	10-20 cm	4.4	4.8	5.0	NS 0.7
	20-30 cm	4.6	4.8	5.2	Sig 0.5

In 2000 soil pH within the 0-10 cm soil layer significantly increased by 1.0 pH unit for the 1 t/ha lime treatment and by 1.4 pH units for the 2 t/ha lime treatment.

Soil pH within the 20-30 cm soil layer significantly increased by 0.6 with an application of 2 t lime/ha in 2000.

2016 Soil pH:

		Lime rate (t/ha)			
Data	Depth	0	1	2	lsd
Average of pH	0-10 cm	4.9	5.4	5.0	NS
	10-20 cm	4.3	5.0	4.4	* 0.6
	20-30 cm	4.3	4.9	4.2	* 0.3

Comments

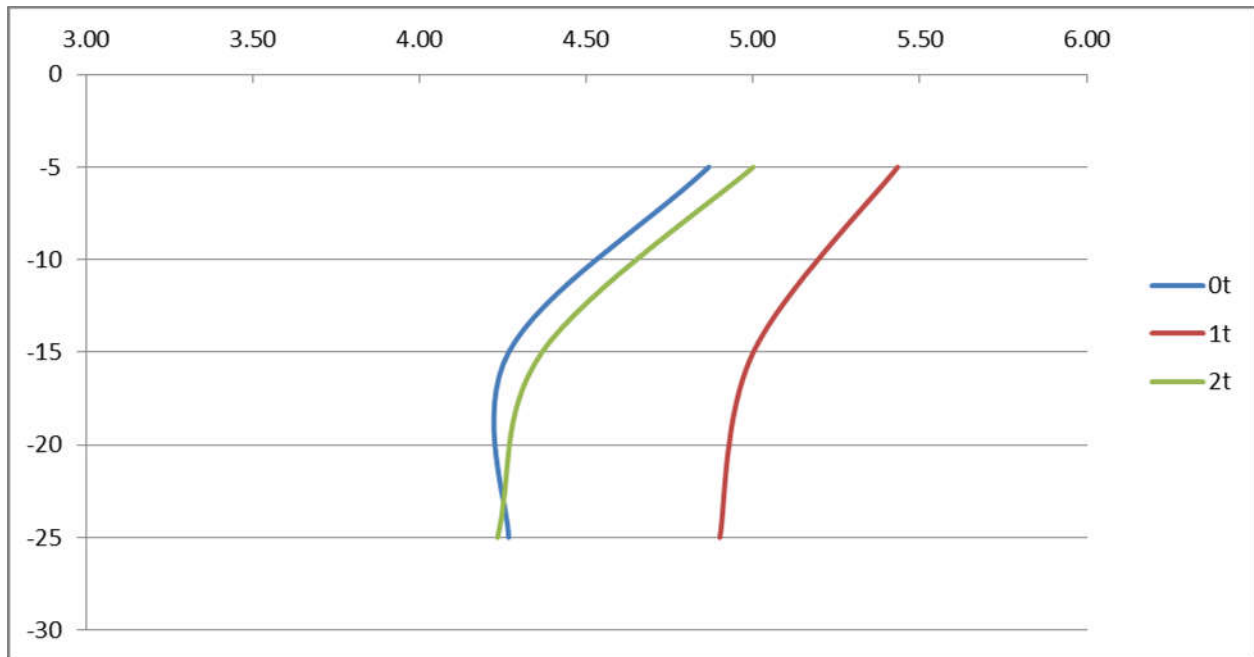
The soil pH measurements made in 2016 are not what was expected, with no significant difference in the surface pH (Figure 1). The data indicates there were significant differences between the nil and 1t/ha lime treatments, the 2t/ha treatment was not different from either the nil or 1t/ha treatment. This is not a typical observation in this type of demonstration.

We are unsure how to interpret this apparent inconsistency. Additional grid sampling (post the current crop) is planned). Given this trial site was established relatively close to the corner of a paddock, it is possible lime, or fertilizer, grain or something else may have been dumped on parts of the trial, and influenced the preliminary results we have obtained.

Since 2008, there have been 2 applications of 2t/ha across the trial. The quality of the lime source is not known, but it has been speculated it was not very high quality. Our understanding is major road works were done in Geraldton in the time frame of the two subsequent lime applications, there was 'lime sands' of unknown quality (neutralizing values in the 40 to 60% range have been speculated) being offered to some growers to aid in road realignment works.

There has been considerable decline across all treatments since monitoring of the trial ceased in 2000. Further, there is inconsistency between the measured pH, of the initial 1t/ha and 2t/ha rates. At this juncture, we have been unable to determine the reasons why the initial 1t/ha treatment is in fact sitting above the target soil pH profile of 5.5 in the surface layer, and then 4.8 at the deeper depths. Further sampling to investigate this anomaly is planned, and will be reported upon in the next phase of this project.

Figure 1. 2016 Soil pH at 0, 1 and 2t/ha of lime applied in 1996 (20 years) post trial establishment:



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