Current Practices and Extension on Acid Soils in SA
Description of Practices

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There are predominantly four techniques that will assist in ameliorating acid soils. These are:

- Application of liming material
- Use of acid tolerant plants
- Use of management practices which reduce the rate of acidification
- Application of other types of neutralising agents

Extent of Practices

1. Application of liming material

Within SA liming materials include predominantly agricultural limes (naturally occurring crushed or sieved limestone, shell grit, lime sands or lake deposits - predominantly calcium carbonate) and dolomites (crushed or sieved deposits of calcium and magnesium carbonate) and variations between. A small amount of magnesite (predominantly magnesium carbonate) has also been used. A predominantly calcium carbonate product produced as a by-product of soda ash is also used as a major lime source.

Table 4 lists lime suppliers in SA and describes the quality of the lime that they produce.

Estimates of Production/Sales by Region in SA

The 1998/1999 and 1999/2000 financial year estimates were derived by personal interviews undertaken with lime suppliers for particular regions. The regions have been divided into: Eyre Peninsula, the Northern Agricultural Districts, the Mount Lofty Ranges, the South East and Kangaroo Island. Figure 1 shows these regions and the areas of land containing acid soils and soils with the potential to become acidic. Table 1 describes the estimated amount of lime in tonnes used in specific regions of South Australia.

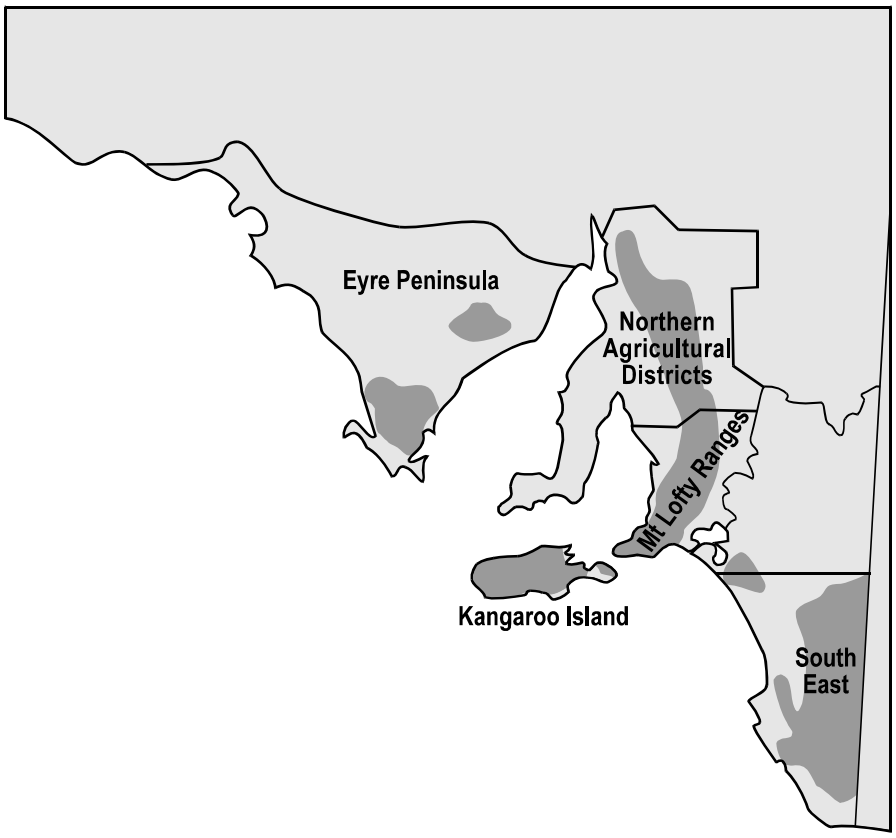
Table 1: Estimate of lime used in tonnes for particular regions of South Australia

Region	1998/1999 (t)	1999/2000 (t)
EP –Eyre Peninsula	5,000	10,400
NAD –Northern Ag Districts	30,000	28,000
MLR-Mount Lofty Ranges	33,400	37,500
SE – South East	20,750	39,319
KI –Kangaroo Island	11,000	18,000
Est State Production/use in SA	100,150	133,219

Source: Hughes (2000).

NB: this is an estimate of lime sold into South Australia only. Many of the South Australian lime suppliers sell interstate particularly into Victoria and parts of NSW. For example, some quarries in the South East produce more lime for interstate buyers than for South Australia.

Figure 1: Soil Acidity in South Australia (Hughes 2000)



Land containing acid soils and soils with the potential to become acidic -

Roarty, 1997 used Department of Mines and Energy (DME) data to estimate agricultural lime production within Australia for the period 91/92 to 96/97. His figures indicated a large several fold increase for SA during this period. However, it is expected his estimates contain a component of production in South Australia, which has been sold interstate. This maybe up to 30% of total as producers in the SE and the central areas all sell interstate. The DME data also misses out some smaller lime producers on Kangaroo Island and the Eyre Peninsula. Table 2 describes the amounts of limestone produced for agricultural purposes in tonnes for particular years.

Table 2: Amount of limestone production used for agricultural purposes in particular years for SA

Year	Limestone production for Agricultural Purposes (tonnes)
91/92	14,917
92/93	36,859
93/94	56,190

94/94	86,040
95/96	87,892
96/97	93,685

Source: Roarty (1997)

Costs of Agricultural Lime

Lime Sand Deposits are generally sold in the $7 to 12/t
Crushed Limestone is normally sold around $15 to 22/t
Dolomite is around $20/t to $25/t
Nutrilime/Soda Ash By Product (predominantly calcium carbonate) around $10/t

Lime Spreading Costs

Generally around $8 to $10/t

Lime Cartage Costs

Will vary with distance from $3/t close to pit to about $10/t 100kms from the lime pit.

Rates of lime spread at 2.5 t/ha will cost around $45 to $100/ha.

Agricultural Lime Regulations

There are limited regulatory controls on agricultural lime quality in SA with suppliers required to express some measure of lime quality and notifications of toxic elements, human health issues, etc.

2. Use of Acid Tolerant Plants

As a generalisation, within SA acid tolerant plants are grown where they are the best performing pasture plants rather than solely on the basis of acid tolerance (eg sub clover/ ryegrass pastures). Therefore, the use of acid tolerant plants is widespread in the higher rainfall grazing areas but quite uncommon in the cropping districts. There are however many situations where the renovation of a pasture or sowing a dryland crop to an acid sensitive species maybe delayed until lime has been suitably incorporated (eg when sowing lucerne, phalaris or canola). Where hay species are sown into predominantly grazed land acid tolerant species are generally selected unless liming has taken place (eg triticale, oats).

Acid tolerant plants have a limited future where they continue the rate of acidification and there is now some interest in low input native pastures etc with low acidification rates for rocky or steep areas where it is difficult to apply lime.

3. Use management practices that reduce the rate of acidification

The contribution of management practices to the development of acidity is complex and variable. Practices which are used in SA that reduce acidity are;

- Use of less acidifying forms of fertiliser - within horticultural crops such as apples, vines and citrus the replacement of urea with calcium nitrate

or equivalent is quite common, particularly on soils which have developed an acidity problem.

The extra expense of calcium nitrate prohibits its use in dryland agriculture. However, the additional cost of lime required to counteract acidity that is being caused through the application of nitrogen fertilisers is becoming an accepted addition to the cost of using nitrogen fertilisers. Work by Baldock (1999) indicates the cost of liming acidification associated with use of nitrogen fertiliser adds 5 to 10% to the cost of the fertiliser.

The use of soil and plant testing to monitor and match rates of fertiliser to plant requirements is widely used across SA principally to improve returns but with the side benefits of avoiding excessive fertiliser use.

- Sow perennial pasture in non-cropping areas – reduces nitrate leaching and therefore slows the rate of acidification.

  The use of perennial pastures is often proposed for other reasons including;
  - reducing recharge therefore reducing the risk of salinity,
  - increasing ground cover which reduces erosion.

- Where possible feed hay onto paddock in which it was cut - recycles nutrients and alkalinity. Rotation of hay/night paddocks is used particularly on dairies and horse properties to reduce acidification of paddocks where hay has been sourced. Adoption levels are probably relatively low but have increased over the last few years.

4. Apply other types of neutralising agents

Clay spreading

Spreading neutral or alkaline clay on water repellent sands can significantly improve soil pH. Other benefits include, long term reduction of water repellency, improved germination, ground cover and growth and the improved ability of the soil to retain nutrients.

Both alkaline and neutral clays will increase pH significantly. Early indications are this pH rise will probably last in excess of 20 years. In these areas landholders are potentially faced with choosing to lime a paddock to correct pH or waiting until they can afford to clay spread it.

The cost of clay spreading is around about $1/t with rates of 200 to 250 t/ha costing around $200 to $250/ha.

Over the last 20 years it is estimated that about 50,000ha of acid prone areas within SA have been spread with alkaline or neutral clays (about 47,500ha in the SE, 500ha on Kangaroo Island and 2000ha on the Lower Eyre Peninsula).

Alkaline Irrigation Water

Alkaline irrigation water can significantly increase pH through the addition of lime and sodium bicarbonate in the water. Irrigated pastures within the SE and some parts of the MLR have had significant pH rises and in some cases now have alkalinity issues. An estimated 7,000 ha of acidity prone land, principally in the SE, is corrected by the addition of alkaline irrigation.

Summary of land use on an agro-ecological and land use basis

Table 3 provides a summary of the practices being used by landholders in SA to combat soil acidity. The table describes the practices on an agro-ecological area and land use basis. This can be used when comparing between states.

Table 3: Practices used to combat soil acidity on an agro-ecological and land use basis

AER	10.Temperate slopes and plains			8. Wet temperate coasts	
Land Use	Nearly continuous Crop EP/NAD	Crop Pasture Rotation EP/NAD	Dryland Lucerne NAD/SE	Continuous Grazing MLR/KI/SE	High Rainfall Crop Pasture SE/KI/MLR
Lime Use(t) State 98/99 100,150 t	23,000	7,000	5,000	44,150#	21,000
Trend over last 5 years	Large increase	Large increase	Small increase	static	Large increase
Rate of lime application *Where farmers are liming*	2.5t/ha poss every 5 to 10 years although many liming for first time	2.0 to 2.5t/ha poss every 5 to 10 years although many liming for first time	2.5t/ha poss every 5 to 10 years although many liming for first time	2 to 3 t/ha every 10 years	2.5t/ha poss every 5 to 10 years although many liming for first time
Reliability of Answers [1]	3	3	2	3	3
Practices used AER by cropping system					
Do nothing	Some	Some	Some	Some	Few
Use lime	Some	Some	Some	Some to many on intensively grazed properties eg dairies	Many
Grow acid tolerant plants	Nil	Nil	Nil	Many do by accident , few by design	Few
Use less acidifying practices	Nil	Nil	Nil	Few	Nil
Alkaline/ neutral clays spread	Some	Some	Some	Some	Some
Alkaline irrigation water	Nil	Few	Some	Some in SE	Nil

probably a component of horticultural use in this as well of the order of 5,000 to 10,000 tonnes. This has increased over the last 5 years with vineyard expansion but is likely to decrease over the next couple years

1 reliability of answers was assessed on a 1 to 5 scale with 1 unreliable and 5 very reliable

Table 4: Lime Suppliers SA (update 7/2/01)

Lime Suppliers	Contact	Phone/Fax	Address	Products	Quality					Pit Location	
					Ca%	Mg%	NV	ENV	RH		
ACI Industrial Minerals	Ian Hampel	08 835 25977 P 08 8352 6411 F 041 8834581 M	PO Box 87, Hindmarsh 5007	1.Shell grit 2.Dolomite 3. Crushed limestone	35	0.5	90.5			Pt Parham, NAP Tantanoola SE Caroline SE	E 404000 N 5886000 E 456000 N 5826000 E 493000 N 5805000
Agricola Mining Pty Ltd	Saul Kennedy	08 8276 5523 P 08 8374 2977 F	211 Victoria Square, Adelaide 5000	1.Dolomite 2.Magnesite 3.Fine Lime	18.8 9 26.4	13 19 5	102 100 87			Lower Yorke Pen-Warooka Meningie, Murraylands Robe, SE	E 739000 N 6115000 E 404000 N 5886000
BHP Mining		New number shortly	Proper Bay, Port Lincoln 5606	Lime sand	31	1.5	97		26	Coffin Bay EP	E 547000 N 6163000
Cawte's Aglime Pty Ltd	Neville Cawte	08 8532 1555 P	PO Box 1356, Murray Bridge 5253	Crushed Limestone	24	2.2	77	56	64	Murray Bridge	E 345000 N 6108000
DK Quarries Pty Ltd	Tim McDonald	08 8682 2000 P	Pine Freezer Rd, Port Lincoln 5606	Lime sand	92.4	5.2	96.7	83.1		Pt Lincoln EP	E 576000 N 6158000
Gambier Earthmovers Pty Ltd	John Summerfield	08 8725 4093 P	PO Box 378, Mount Gambier 5290	Crushed Limestone Dolomite	35	0.5	99		75	Mt Gambier SE	E 479000 N 5809000 E 473000 N 5816000
Henschke Industries Pty Ltd	Graham Henschke	08 8762 2080 P	Blackwell Rd, Naracoorte 5271	Crushed limestone	32	0.4	92		43	Naracoorte SE	E 483000 N 5905000
B Jamieson	Barry Jamieson	08 8559 6178 P	PMB 52 Flinders Chase Service via Kingscote 5290	Lime sand	25	1.1	78		52	Little Sahara KIs	E 700000 N 6017000
P. Whitehead	Peter	08 8725 9666 P	Box 1088	1.Crushed Limestone						Mt Gambier	E 473000

	Whitehead	08 8724 1333 F	Mt Gambier 5290	2.Dolomite						Mt Gambier	N 5809000 E 474000 N 5814000
Penrice Soda Products Pty Ltd	Andrew Maynard John Fogarty	08 8563 8800 P 08 8564 3358 F 08 8409 9500 P 040 7183518 M	PO Box 234, Angaston 5353 Magazine Rd Dry Creek. 5094	1.Crushed Limestone 2. Nutrilime byproduct soda ash	39 40	0.4 0.5	97 104	 59	56 87	Angaston Dry Creek	E 321000 N 6183000 E 279000 N 6143000
Southern Lime	Mike Frost	08 8431 1999 P 08 8364 1839 F 041 4332438 M	29 Dequettville Tce, Kent Town 5067	1.High Mg Crushed Dolomite 2. Low Mg Crushed Limestone	24.5 29	8.6 4	98 101	80 80		Sellicks Hill Sellicks Hill	E 269000 N 6087000 As above
Teagle Excavations Pty Ltd (Lake Leake)	Bruce Teagle	08 87348263 P	Millicent 5280	Crushed Limestone	27	1.7	82		44	Lake Leake SE	E 464000 N 5838000
EP Super Spreaders	Ron Major	08 8676 2368 P	Cummins	Lime sand	32.4	0.8	88	75		Lake Greenly EP	E 542000 N 6196000
C .Halloran	Dave (Chook) Halloran	85594254 P 85594257 F	PO Box 79 Pardana	1.Lime sand 2.Lime sand	28	1.2	83		41	Howards Pit Kis D'estrees Bay KIs	E 708000 N 6023000 E 743000 N 6028000

State Programs

Extension Programs

In SA, the peak body for soil acidity monitoring and extension is the SA Soil Acidity Reference Group. This collaborative group is made up of representatives from CSIRO, State Government, Limestone Companies, Lime and Fertiliser Spreaders, consultants and farmers representing different zones within SA. (contact Brian Hughes, Chairman, PIRSA, 08 83898800)

Currently a jointly funded project titled, *Balancing Acidity in SA Soils* has been developed through the SA Soil Acidity Reference Group. Funding has been obtained from the Natural Heritage Trust, Primary Industries and Resources SA and through other contributing organisations and industry groups. This project aims to increase the rate of liming of South Australia's acidic soils by the delivery of several subprojects. These subprojects include;

- survey of landholder attitudes to acidity
- a marketing program targeting landholders,
- workshops etc to improve understanding of agribusiness,
- producing support material including publications
- monitoring lime use and acidity.

It is hoped that these subprojects will;

- persuade land managers of the critical importance of acidity to the sustainable use of their land,
- encourage land managers to monitor their soil pH
- encourage land managers to implement liming programs on acid soils.

These subprojects target specific regions throughout SA affected by acidification.

Components of the marketing and training program over the last twelve months have included:

- Marketing and promotional campaign through local, state and radio media including awareness, case studies, promotion of acid soils week.
- Promotion and development of acid soils week including soil testing for pH and recommendations.
- Development of agribusiness database and regular newsletters covering acidity issue.
- Development of publications.
- Regional and company training workshop with agribusiness providers.

This project commenced in March 99 and will run until Sept 01.

The key staff involved in this has been about 1.0 FTE through PIRSA, Lime company staff, lime and fertiliser spreaders and CSIRO support. Agribusiness merchants, private consultants and landcare support staff have been involved in the promotion and distribution of kitsThe Rural Promotion Group has been contracted to undertake certain components of the project on a consultancy basis.

Total funding for the project from all partners amounts to about $500,000 over the three years.

Survey of Landholders Attitudes to Acidity Summary

In March 1999 at the commencement of the Balancing Acidity project a baseline survey of farmer attitudes towards acidity was undertaken. This process has given an insight as to farmer awareness at the time. The survey targeted farmers within the areas of the state with soil acidity.

Some of the survey findings were:

- Acidity has a low recognition as a land degradation issue.
- Farmers had a reasonable understanding of what acidity is and the effects.
- Causes of acidity are poorly understood and superphosphate is erroneously seen as a major cause.
- Erroneous belief by farmers that gypsum can be used to treat acidity.
- 67% of farmers in these areas recognised acidity problems on part of their farm.
- 36% of farmers spread lime or dolomite.
- Rates of lime generally sufficient to ameliorate past acidification and most expect to re-lime within 10 years.
- Adverse effects of soil acidity recognised include nutrient imbalances, manganese deficiency.
- Main barrier to liming was costs, particularly on Kangaroo Island.
- Farmers recognised the long term implications if they did not lime.
- Regional variation of understanding the benefits of liming including.

Kangaroo Island - best understanding of soil acidity however, economic returns are a major limitation to using lime,
Eyre Peninsula - least aware, need for demonstrations, fear over trace element imbalances,
Northern Agricultural Districts - consultants provide a role as main information source,
Mount Lofty Ranges - high levels of farmers believing they don't have an acidity problem in an area where acidity is widespread,
South East- clay spreading the major treatment option as well as liming

It is proposed to repeat this survey early in 2001 to determine what impact the program has had.

Contacts - project subcommittee

Project Leader - Brian Hughes, PIRSA 83898800
Richard Merry - CSIRO Land and Water 83038422
Richard Payne - PIRSA 83039634
Mike Frost - Southern Lime
Phil Peters - Mt Compass Fertiliser Spreaders
Regional PIRSA Staff
Eyre Peninsula, David Davenport 86883403
Kangaroo Island, Lyn Dohle 85532222
Northern Ag Districts, David Woodard 88423900
South East, Dale Lewis 87629172
Mount Lofty Ranges, Brian Hughes 83898800

Extension Publications

PIRSA Bulletin 1/99 - Lime acid soils to stay in business

Richards AF, 1992. Improved criteria for predicting and ameliorating soil acidity in the higher rainfall areas of South Australia. Wool Research and Development Fund Project DAS – 14P. Technical report No. 196, April 1992. Department of Agriculture SA, CSIRO – Division of Soils.

Research

Current and Historical Research

Current
Current research within SA is largely undertaken through University of Adelaide, CSIRO Land and Water and some applied research through PIRSA, SARDI and Land care Groups.

At the University of Adelaide post-graduate studies are being undertaken in two areas

- Understanding processes of acidification and reclamation on acid topsoil, sodic alkaline subsoil red brown earths of the mid North.
- Understanding the effects of acidifying cropping practices on soils with low levels of natural calcium carbonate in their soil surface

Supervisors for these projects are;
- David Coventry - University of Adelaide, Roseworthy Campus
- Richard Merry - CSIRO Land and Water 83038422

At CSIRO current research includes examining new methods of soil testing using infra analysis - supervisor Richard Merry

PIRSA/SARDI and Landcare Sites across SA include;

1. Comparison of different lime sources on soil and plant indicators of grass tetany at Wistow - N Fleming (SARDI, Waite)/ B Hughes
2. Acidity/Liming Demonstrations Plots - Angaston Agricultural Bureau
3. Acidity/Liming/Gypsum Demonstrations Plots and Field Day Publication - Kapunda Landcare Group
4. Spring Valley Landcare Group Acidity/Liming Demonstrations Plots
5. Waterloo Agricultural Bureau Gypsum/Sodicity/ Acidity/Liming Demonstrations Plots
6. Todd River Landcare Group Acidity/Liming Demonstrations Plots
7. Edillilie Acidity/Liming Demonstrations Plots

Historical research

Historical research in SA included work by Cook (1925), which acknowledged response to lime in subterranean clover at Kybybolite. Russell (1960) related pH decline to increases in organic matter at Kybybolite and Lewis *et al.* (1987) showed pH decline was related to the age of pasture in the South East.

Jointly funded historical research established in the 1980s included the establishment of 9 pasture sites spread throughout Kangaroo Island, MLR and the SE which were monitored to determine growth responses and the effect on trace elements of liming(Richards, 1992). In conjunction with this program a baseline survey was undertaken of 224 sites to determine the extent of acidity and interactions with trace elements. Several of these sites are still showing responses (Dyson, C – *pers comm*). Some re-liming of some plots was undertaken in 1997.

Considerable pH and cation monitoring work by Merry (unpublished) has also been undertaken with these sites summarised in the acidification rate section of the NLWRA soil acidity project.

Web Sites

PIRSA

www.pir.sa.gov.au

CSIRO Land and Water

www.clw.csiro.au/

References

Baldock (1999) Background – Fertiliser Nitrogen in Soil. GRDC – Background Information for Farm Advisers. April 1999.

Cook, L J (1925) J Dept Agric S Aust 28:807

Lewis, DC, Clarke, A Land Hall, W B Accumulation of Plant Nutrients and Changes in Soil Properties of Sandy Soils under Fertilized Pasture in South-eastern South Australia II. Total Sulfur and Nitrogen, Organic Carbon and pH

Richards A F (1992) Improved Criteria for Predicting and Ameliorating Soil Acidity in the Higher Rainfall Areas of South Australia. Dept of Ag SA, Tech Report No 196

Roarty M (1997). Market Analysis of Agricultural Limestone and Gypsum in Australia Historical lime estimates. Mican Resources. CRC Soil and Land Management.

Rural Promotions Group (1999) Desk Top Study on State Based Extension and Communication Programs prepared for SA Soil Acidity Reference group

Russell, J S (1960) Soil fertility changes in the long term experimental plots at Kybybolite, South Aust. I . Changes in pH, total nitrogen, organic carbon and bulk density. Aust J Agric Res II, 902-26