Natural Resources
Eyre Peninsula

RURAL SOLUTIONS SA
PIRSA

Final Project Report

Project title: *Farming Acid Soil Champions on Lower Eyre Peninsula*

Eyre Peninsula Natural Resources Management Board & Department of Environment, Water and Natural Resources

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LEADA Lower Eyre Agricultural Development Association

Cockaleechie Landcare Group

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EXECUTIVE SUMMARY

Soil acidity is a significant issue on an estimated 178, 000 ha agricultural lands of lower Eyre Peninsula (LEP) and eastern Eyre Peninsula (EEP) (Forward 2013). Although soil acidification is a natural process it can be accelerated through agricultural production practices. An estimated 125, 000 ha on Eyre Peninsula have surface soils below the critical pH value of 5.0 ($CaCl_2$) (Forward 2013). Also of concern is the number of LEP surveillance sites with subsurface layers below pH 5.0 ($CaCl_2$) (Masters 2015).

The Eyre Peninsula Natural Resources Management board recognises soil acidity as a significant issue in these areas and has included as a soil condition action target (Target A) in the regional NRM plan. In response, the board; with funding support from the Australian Government and the Department of Environment, Water and Natural Resources, have developed projects around this target. The aim of these projects is to increase awareness of the extent, impacts and treatment options of low pH soils in the acid prone areas of Eyre Peninsula.

The Eyre Peninsula Natural Resource Management Board "Farming Acid Soils Champions" project supported by LEADA and the Cockaleechie Landcare Group, was a pilot project funded by DEWNR's "Healthy Soils for Premium Food" program and the Australian Government's National Landcare Program and implemented in early 2016. This program, completed in June 2016, had the objective of developing a group of farmers to champion the cause of managing acid soils in Lower Eyre Peninsula by providing landholders with the knowledge and skills to identify areas of their farm which may be acidic and develop an action plan for these areas.

This was achieved through a series of activities including 2 workshops and mapping of 16 paddocks (1080 ha) using a Veris pH mapper. Mapping revealed a high degree of pH variation within and between paddocks with an average pH variation of 3.5 units across all sites. The cost of a targeted lime application rate based on the mapping was compared to the cost of a uniform application rate of 2.5 t/ha lime across the whole paddock. The average forecast potential cost saving was $2,242 per paddock (41% of the cost of lime applications). The lowest cost savings were on those paddocks with a high proportion of acid soils, as the calculated lime required from pH mapping was not much different to a uniform application rate on these sites. The highest potential savings were on those paddocks with a high degree of variability, particularly those with a significant proportion of alkaline soils within the paddock.

Landholder paddock information was entered into the "lime maintenance replacement model" with the estimated annual lime replacement to offset acidification averaging 264 kg lime/ha/year depending on soil type, crop type and yield and fertiliser nitrogen inputs. This accords with the estimated acidification rates from other work conducted in the region.

Participants were asked to provide feedback on the program and more than 88% found the program very interesting and very valuable with most participants stating that they would make changes to the management of their property as a result of the program.

1 INTRODUCTION

An estimated 178, 000 ha of agricultural land on Eastern and Lower Eyre Peninsula is thought to have surface and subsurface soil layers susceptible to acidification (Forward 2013). It is estimated that 125, 000 ha of at risk soils has currently has surface pH below 5.0 ($CaCl_2$) (Forward 2013). In a recent analysis undertaken by DEWNR, D. Maschmedt has indicated that without treatment the area of acidic soils on Eyre Peninsula will increase over the next few decades as acidity develops on soils current considered not acid prone (Hughes, pers. comm June 2015).

The EPNRM board recognises soil acidity as a significant issue in these areas and have included it in the soil condition action target (Target A) of the regional NRM plan. With funding from the Australian Government and DEWNR, the Board have developed projects around this target delivered by PIRSA in 2013/14, 2014/15 and 2015/16. These projects aimed to increase awareness of the effects of soil acidity in the acid prone areas of Eyre Peninsula through targeted soil sampling programs, publication of newspaper articles, workshops for landholders, agribusiness and government staff and the establishment of three liming demonstration sites. Results from these projects indicate that under current farming practices and recent seasonal conditions acidification is happening faster than was historically estimated (Masters 2015)

2 OVERVIEW OF "FARMING ACID SOILS CHAMPIONS" PROGRAM

The NREP "Farming Acid Soils Champions" project delivered between January and June 2016 was funded by DEWNR's "Healthy Soils for Premium Food" program and the Australian Government's National Landcare Program and supported by LEADA and the Cockaleechie Landcare Group. Under this pilot project a program of activities was developed which had the objective of developing a group of farmers to champion the cause of managing acid soils in Lower Eyre Peninsula. A program of activities was developed

16 landholders (8 from LEADA and 8 from the Cockaleechie Landcare Group) were invited to participate in the program with the key criteria being;

- Participants were willing "champion" the cause of managing acid soils; sharing their knowledge and skills with other landholders in the district
- Participants would pay for pH mapping 1 paddock around 40 ha in size ($11/ha), and
- The paddock had areas which were acidic and did not contain rocks.

An initial workshop was held in at Cummins on 30th March 2016. Brett Masters, (PIRSA) presented an overview of the causes of soil acidity and the impact of soil type and farming systems on acidification rates. Mary Crawford (NREP) led a mapping exercise and field visit to show participants how they could use an aerial photograph and soil pH kit to identify zones of varying soil pH within a paddock. Kym I'Anson undertook pH mapping using the Veris pH manager on the 16 "Farming Acid Soils Champions" paddocks in early April 2016. A complete list of participants and the paddock areas mapped under the program can be found in Appendix 1.

A second workshop on the 21st of June 2016 gave landholders an opportunity to discuss the results of their pH mapping, with input from Andrew Harding (PIRSA Clare), Kym I'Anson and Brett Masters. Andrew Harding presented an overview of the state-wide pH mapping results and management of subsoil acidity with Brett Masters presenting the LEP pH mapping results. A number of new tools for managing soil acidity including a "lime maintenance rate model", "lime calculation tool" and "lime comparison tool" were also presented at this workshop.

3 SOIL PH MAPPING

3.1 Mapping using a field pH kit.

Prior to the first workshop participants were asked to select one paddock of around 40 ha in size to be mapped. At the first workshop each participant was provided a laminated aerial photograph of their paddock and a pH field kit. Participants were asked to use the knowledge gained about soil type influences on pH and indictor plants to determine areas of low pH in this paddock. They were then asked to map the paddock using the field pH kit to ground truth their expected pH variation

(pH field kits return a pH reading that is approximate to pH (H_20) with pH ($CaCl_2$) some 0.5 to 0.8 units lower than this).
As this workshop was in late March many growers started seeding in the week following the workshop and only a few growers (18 %) undertook mapping using their field kit prior to end of the project. The 3 growers who undertook manual mapping of the paddock said it was a useful exercise as it confirmed their "gut" feel on which areas of the paddock were more alkaline and which areas were more acidic'.

At Moroney's site (Figure 1) Luke was able to confirm the pH of the alkaline rise at the southern end of the paddock and discovered some quite low surface pH of around 4.5 (field kit) on the sandy ironstone soil in the centre and northern end of the paddock.

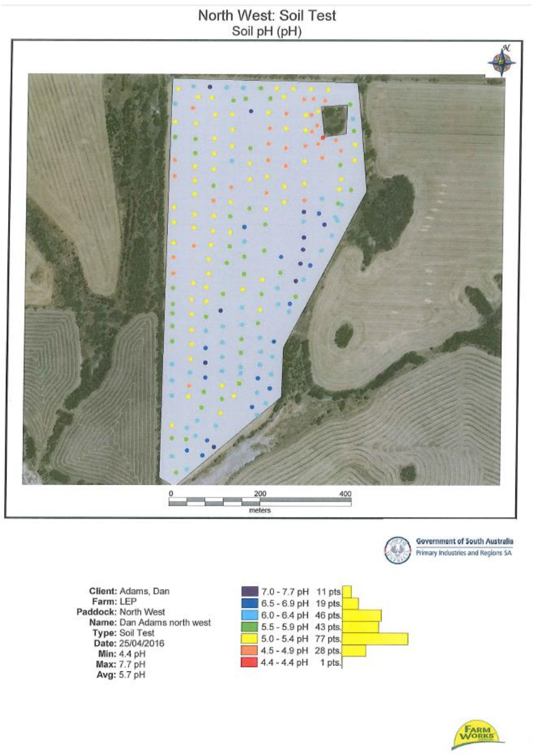
Figure 1. **Aerial photograph of Moroney's paddock with field kit pH values and pH zones drawn in.**

One landholder said that by the end of mapping he was reasonably confident to predict which areas might be acidic based on the high levels of ryegrass present.

3.2 **Mapping with the Veris pH manager**

Following the first workshop and prior to seeding each of the selected paddocks were mapped Kym I'Anson using a Veris "pH manager" mapper (Figure 2). Under the program 16 paddocks totalling 1060 ha was mapped (Appendix 1). Kym also mapped a further 44 paddocks (2740 ha) for landholder whilst he had the machine in the region.

Figure 2. **Kym I'Anson undertaking mapping at Coulta.**



Sampling was conducted at 36 m spacings, equating to 10 to 12 sample locations per ha. Two probes measured pH on a soil sample taken from around 7cm depth at each sampling location. Where the readings varied by more than 0.5 pH units the sample was discarded.

Veris probes are calibrated against pH (1:1) soil analysis. These values tend to fall between those from the 1:5 soil/water extract (pH water) and pH ($CaCl_2$). Validation of Veris readings against laboratory results from a range of soil types suggest that, in acidic soils the Veris readings are in the order of 0.3 to 0.4 of a pH unit higher than pH ($CaCl_2$).

The point data pH map (Figure 3) shows the pH values from the Veris mapper at geolocated sample points adjusted (reduced by 0.3 of a pH unit) to approximate pH($CaCl_2$). All values in this report are have been adjusted to approximate pH ($CaCl_2$) except where otherwise stated.

Figure 3. **pH values from Veris sampling – Adams, Cockaleechie**

Soil samples were taken in each paddock and sent to a laboratory for analysis to validate the Veris pH readings. Comparison of the Veris machine pH readings against laboratory analysis of soil pH ($CaCl_2$) returned an R^2 value of 0.71 showing a strong correlation between pH readings from the Veris machine and pH ($CaCl_2$). (Figure 4)

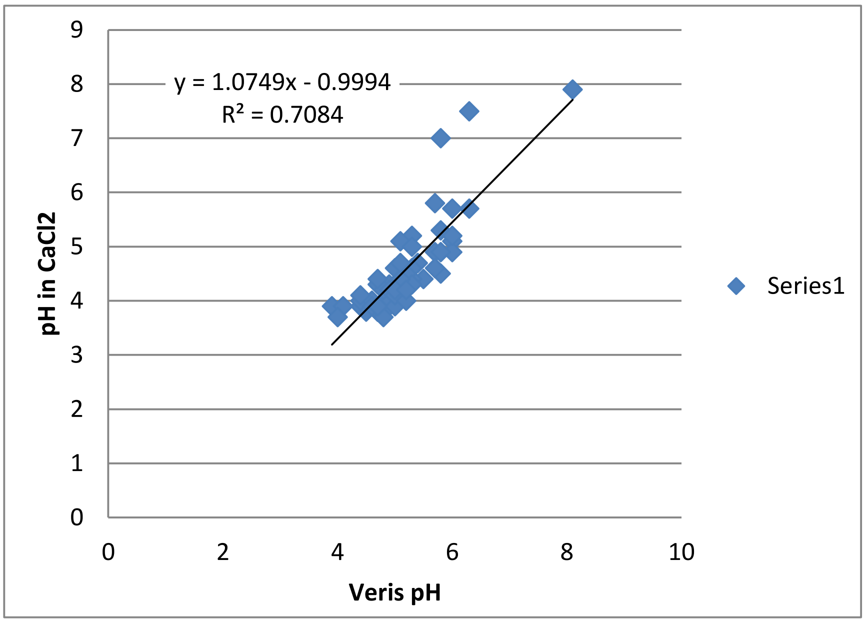


Figure 4. **Regression analysis Veris machine pH readings against pH (CaCl2)**

The lowest soil pH reading on all sites was 3.5 with 8.5 the highest reading. There was a large degree of variability in pH within and between sites with an average site variation of 3.5 pH units (Table 1).

Table 1. Variation in soil pH within sites.

	All Sites	Site with least variation	Site with most variation
Lowest pH ($CaCl_2$)	3.5	4.3	3.5
Highest pH ($CaCl_2$)	8.5	5.8	7.9
pH variation (units)	3.5 (mean)	1.5	4.4

The point data was extrapolated to form polygons representing zones of different pH ranges using FarmWorks software. Figure 5 provides an example of the pH zone map produced for Adams, Cockaleechie.

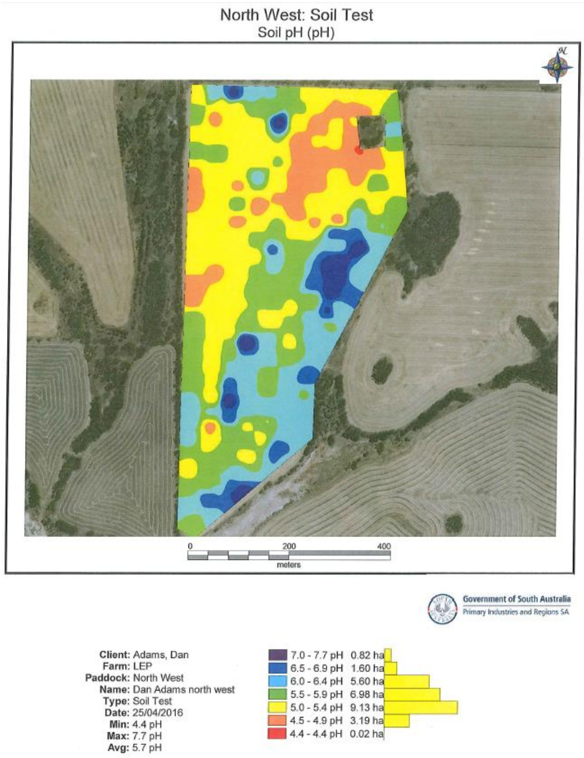


Figure 5. Soil pH zone map – Adams, Cockaleechie

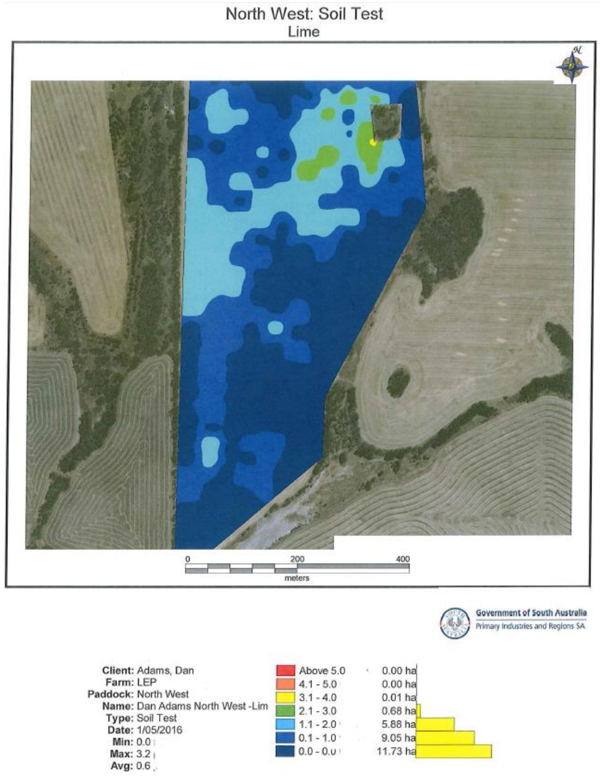


Figure 6. Lime prescription map – Adams, Cockaleechie

Lime prescription maps (Figure 6) were generated by subtracting the current soil pH levels (from Veris map) from the target pH 5.5 ($CaCl_2$). This value was multiplied by a soil texture factor (3.0 t/ha for a one unit pH change on a sandy loam) to determine the rate of lime required to increase the pH of each zone to 5.5 ($CaCl_2$).

Of the 1080 ha mapped under the project, 63% was below the target surface pH of 5.5 with 33% below the critical pH of 5.0 ($CaCl_2$). 13% of the area mapped was above the pH range considered best for plant growth (5.5 to 6.5 $CaCl_2$) (Table 2).

Table 2. Proportion of different pH zones.

pH range	**% of total area**
<4.4	8
4.5 – 4.9	25
5.0 – 5.4	30
5.5 – 5.9	15
6.0 – 6.4	9
6.5 – 6.9	4
>7.0	9

3.3 **Cost/benefit of targeted lime application**

Analysis of the potential cost savings on the liming operation from mapping the paddock compared to a uniform lime application rate was also undertaken for each site. The lime application costs included the cost of lime product ($12/t), freight and application ($20/t) and $12/ha for mapping. The average forecasted potential savings across all sites was $2,242 (or 41% on the cost of the liming operation) with the highest potential savings of $9139 and the lowest “savings” of -$992. A full summary of the potential cost savings by mapping by site can be found in Appendix 2.

7 sites (43%) had potential cost savings above the mean and 9 sites (56%) returned potential cost savings below the mean. The greatest potential for reducing the cost of the lime application was in paddocks with highly variable soil types, particularly where acidic ironstone soils were interspersed with alkaline red brown earths such as at Telfer, Green and Pedler. However, these results may not reflect the true benefit as it is likely that landholders would recognise that some areas would require higher lime application than other areas and may not have applied a uniform rate of 2.5 t lime/ha across the whole paddock.

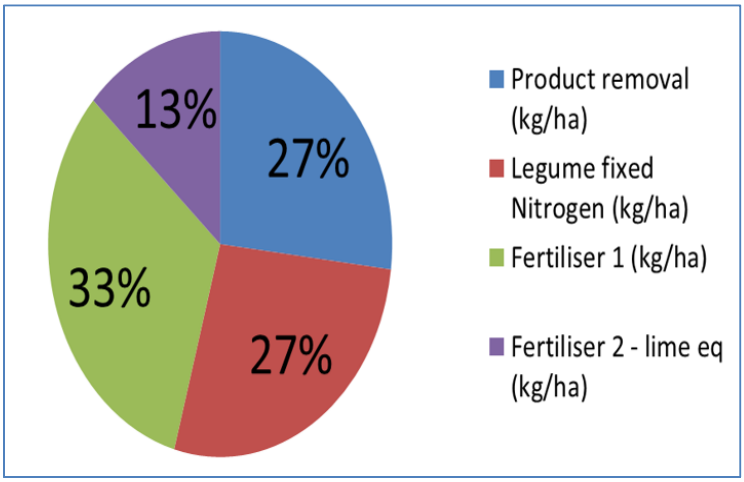
The lowest forecasted potential savings are on those paddocks that have a very high proportion of the total paddock area which is acidic and requires lime. In these paddocks the lime requirement for both the uniform application and the prescription rate are similar, with the cost of mapping the paddock actually resulting in additional costs compared to a uniform application rate. Moroney, Holman and Gameau sites were examples of this.

On 1 site (6%) there was negative cost benefit (-$992) forecast from mapping the paddock compared to a uniform lime application rate of 2.5 t/ha over the whole paddocks. However, due to the very high proportion (48%) of this paddock requiring required greater than 3 t/ha to bring surface pH levels above 5.5 ($CaCl_2$) there is a risk of under-liming the paddock if only 2.5 t/ha is used. When compared to a revised uniform rate of 3.5 t/ha a potential cost saving of $391 (or 6% of the lime operation costs) was forecast.

4 ACIDIFICATION RATE MODELLING

Paddock information forms were sent to each landholder to collect information on the rainfall, crop type and yields and nitrogen fertiliser inputs over the 7 year period to 2015. Of the 16 participants, 9 (56%) returned these forms and this data was entered into the “lime maintenance rate model”; a new tool developed to estimate the replacement lime required to offset acidification caused by agricultural production on the site).

Based on these paddock management inputs and rainfall data for the last 7 years estimates of the replacement lime required to address annual acidification on the “Farming Acid Soils Champions” sites ranged from 175 to 340 kg lime/ha/year (averaging 264 kg/ha/year).



Where rotations included a grain legume/legume pasture break the model estimated the lime required to address annual acidification in the order of 150 to 200 kg lime/ha/year. Under this system the around 30% of the average annual acidification comes legume rotations and 40 to 60% results from applied nitrogen fertiliser (Figure 7).

***Figure 7.* Contribution of nitrogen fertiliser applications to the total replacement lime requirement to for offsetting annual acidification in a 4 year rotation with a legume break.**

However, in high intensive legume free crop rotations (i.e. Canola, Cereal, Cereal) the lime required to offset annual acidification was much high (250 to 430 kg lime/ha/year). This figure accords with the rates derived from pH changes measured on surveillance sampling sites. In these crop rotations 80 to 90% of the replacement lime requirement results from applied N fertilisers (Figure 8).

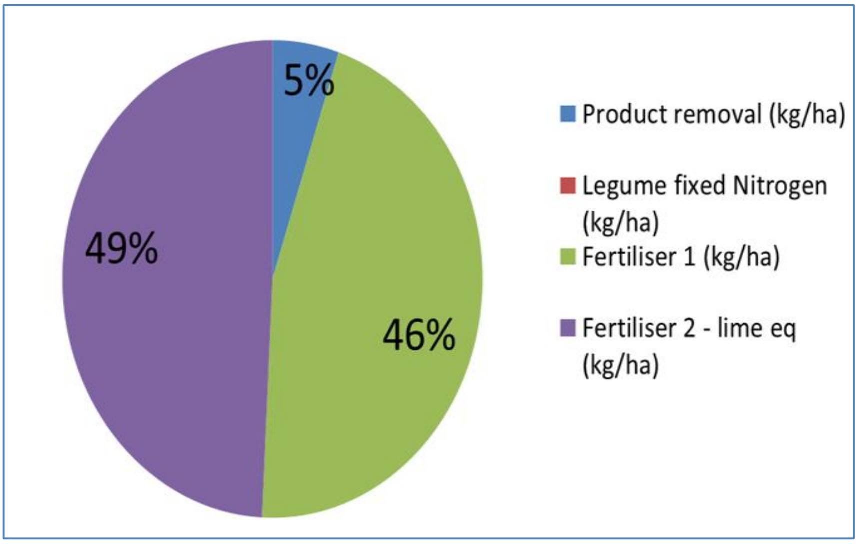


Figure 8. **Contribution of nitrogen fertiliser applications to the total replacement lime requirement to for offsetting annual acidification in a 3 year cereal/oilseed rotation (no legumes).**

5 PARTICIPANT FEEDBACK

12 of the original 16 participants in the program were present at the second workshop. In addition to those participating in the "Farming Acid Soils Champions" project a number of other landholders who have experience in managing acid soils/pH mapping in recent years were invited to attend (4 attendees). Participant feedback was gathered from all 16 landholders who attended the second workshop. This feedback provided valuable information of the value proposition of different aspects of the program to the participants and suggested improvements to the program should a similar program be run in other areas of the state. The feedback forms asked workshop participants to rate the "Farming Acid Soil Champions" program in terms of;

- How relevant the workshop was to their business
- How interesting they found the workshop
- How useful/valuable they found the various components of the program.

The categorical scale of response was from the lowest (none then little) to the highest rating (some and very). There was also a "not applicable" applicable rating for participants who were not present for one or more of the project activities. A full summary of the results can be found in Appendix 2.

All participants reported that the content of the program was of at least some interest to them, with 88% (14 of the 16 participants) saying that the program was very relevant to their business and very interesting.15 of the 16 participants (94%) said that the overview of acidity had at least some value with 81% stating that this was very valuable information. Although 75% of participants thought that the field kit pH mapping exercise had some value, only around 30-40% thought that this was a very valuable exercise. Meanwhile all participants thought that the pH mapping using the Veris machine was very valuable.

88% of respondents thought that the emailed site report following the pH mapping had some value with 69% considering this report very valuable. There were 3 respondents who attended the second workshops but were not part of the broader "Farming Acid Soils Champions" project and thus who did not receive site reports who recorded "Not Applicable" for this question. In the second workshop 81% of participants found the presentations on pH mapping and the overview of mapping results very valuable. 94% of participants found the demonstrations of "Managing pH tools" of at least some value.

12 of the 16 respondents (75%) said that they would make changes to the way that they manage their property based on the information gained from the program, with a further 3 participants (19%) saying that they would probably make management changes on their property as a result of the program.

A number of participants (25%) stated that the program was good with no changes needed to improve it. Ways in which the program could be improved as suggested by the other respondents were;

- Trials demonstrating the rate of lime movement through the soil profile and yield decline at different pH levels
- Field trips to acidic paddocks/lime trial sites
- Some concern expressed around the timing of the night meeting for those with young families
- Need to correlate pH decline to yield decline to show farmers the value of liming.

Workshop participants were asked questions regarding the regularity with which they undertake soil sampling on their properties to test soil pH and nutrition. 81% of participants had soil analysed at least occasionally for soil pH and nutrition with 31% of participants regularly testing soils to monitor soil pH and nutrition. Only around 13% (2 respondents) have never tested soil specifically to monitor pH.

More than 94% of respondents said that they have increased the amount of lime they have spread this year (or intend to do so over the next 5 years) and that they will undertake more soil pH mapping and surface liming as a result of the program. Those who have not yet spread lime state that their increased understanding of the issue will lead to an increase in the areas spread with lime in the next few years. The also highlighted the ease and accuracy of the pH mapper in identifying the spatial variability of pH across a paddock as a major factor in giving them the confidence that they are putting the right rates of lime in the right areas. Of the landholders who have spread lime in the past a key reason for increasing the area that they intend to spread over the next few years has resulted from their observations of better crop growth or improved weed control where lime has been spread. Another factor in the increased application of lime by one farmer this year has been an increase in farm labour to get the job done.

Only around 25% of participants said that they would implement deep mixing of lime to address subsurface acidity. However a further 50% of participants responded that they maybe would employ such a strategy if further information on best practice implementation and successful treatment was available.

The key soil management issues that landholders wanted more information, or feel that further work should be undertaken included;

- Subsoil pH testing and management of subsurface acidity
- Yield decline at different aluminium and pH levels
- Deep incorporation of lime for addressing subsurface acidity
- Impact of historical farming practices on paddock acidification
- Addressing compacted subsurface layers
- Reclaiming saline land.

6 CONCLUSIONS

The first workshop provided participants with a good overview of the causes and impacts of soil acidity, as well as knowledge and skills for identifying soil acidity in the paddock. 81% of participants found this component of the program valuable with 75% of participants considering that the exercise demonstrating mapping a paddock using a field pH kit and aerial photograph had some value.

Participants got a large amount of value from having their paddock mapped using the Veris pH map. Laboratory analysis of soil samples taken for validation of the Veris machine showed a good correlation with the Veris pH values and pH ($CaCl_2$) for LEP soils (R^2=0.71). The ease with which this machine was able to sample and the resolution at which pH could mapped, provided landholders with accurate and useful information on the spatial variation of pH within the paddock.

This has given them the confidence that they are able to apply the right rates of lime to the right areas.

Considerable cost savings could be achieved through pH mapping compared to a uniform lime application rate on the majority of sites (average potential cost saving $2, 242 or 41% of the cost of liming). However, the biggest cost savings where on those sites with highly variable soil types containing a large proportion of alkaline areas. On sites with a high proportion of acidic soils there the cost benefits from mapping compared to a 2.5 t/ha uniform application rate were only small. However, even on these paddock landholders could perceive benefits in improved effectiveness of the lime application by applying the right rates to the right areas.

Modelling using participant's paddocks management data estimated the average lime requirement to offset annual acidification to be $264 kg lime/ha/year. This accords with the acidification rates estimates from other work conducted in the region in recent years.

The feedback gathered showed that most participants considered the program interesting and valuable with most participants stating that they will make changes to the management of their properties as a result of the program and that they are likely to increase the amount of lime applied on their property in the coming years. They attribute this to an improved understanding of soil acidity and acidification rates and observations of better crop growth/weed control observed in areas that have been limed.

7 REFERENCES AND ABBREVIATIONS

7.1 References

Forward, G. (2013) "Soil acidity snapshot report for the Eyre Peninsula Natural Resources Management Region" DEWNR July 2013

Masters, B (2016) "Managing Soil Acidity on Eyre Peninsula", PIRSA, June 2016

7.2 Abbreviations Used in this Report

Al -	Aluminium
DEWNR –	Department of Environment, Water and Natural Resources
EP -	Eyre Peninsula
EEP -	Eastern Eyre Peninsula.
EPNRM -	Eyre Peninsula Natural Resources Management Board
LEADA -	Lower Eyre Agricultural Development Association.
LEP –	Lower Eyre Peninsula
mg/kg -	Milligrams per kilogram, a measure of analyte concentration in soil
N-	Nitrogen
NREP-	Natural Resources Eyre Peninsula
P-	Phosphorus
t/ha -	tonnes per hectare

8 APPENDICIES

8.1 APPENDIX 1. List of pH mapper demonstration sites and attendees

Table 1.

	Landholder	Location	Area mapped (ha)
LEADA	Luke Moroney	Kapinnie	57
	Simon Pedler	Cummins	156
	Bradley Claughton	Yallunda Flat	71
	Andrew Green	Wanilla	72
	Chris Puckridge	Edilillie	46
	Craig Gameau	Edilillie	45
	Julian Doudle	Kapinnie	58
	Jed Siegert	Wanilla	42
COCKALEECHIE LANDCARE GROUP	David Pearson	Yeelanna	82
	Daniel Adams	Cockaleechie	27
	Scott Blacker	Yallunda Flat	53
	Isaac Telfer	Ungarra	87
	Jim Holman	Cockaleechie	79
	Mark Richardson	Cockaleechie	36
	Patric Hannan	Cockaleechie	38
	Zac Glover	Brooker	111

8.2 APPENDIX 2. Potential cost savings on lime application from mapping compared to 2.5 t/ha uniform application rate.

LEADA SITE		Moroney	Pedler	Claughton	Green	Puckridge	Gameau	Doudle	Siegert
Uniform rate applied across whole paddock (2.5 lime/ha)	**Paddock Area (ha)**	57	156	71	72	46	45	58	42
	Tonnes Lime required (t)	143	390	177	181	115	111	146	105
	Cost of Liming	4578	12466	5666	5788	3686	3566	4467	3364
Prescription lime application based on pH mapping (includes cost of mapping)	**Area requiring liming (ha)**	51	48	70	58	8	41	56	4
	Tonnes Lime required (t)	116	46	103	62	5	70	155	2
	Cost of Liming operation	4389	3328	4141	2862	710	2776	5659	583
Cost savings by mapping ($)		$189	$9139	$1516	$2926	$2977	$791	-$992	$2781
% saving on cost of lime operation compared to Uniform rate 2.5 t/ha		4%	73%	27%	51%	81%	22%	-21%	83%

COCKALEECHIE SITE		Blacker	Pearson	Adams	Telfer	Holman	Richardson	Hannan	Glover
Uniform rate applied across whole paddock (2.5 lime/ha)	**Paddock Area (ha)**	53	82	27	87	79	36	38	111
	Tonnes Lime required (t)	132	205	68	219	198	89	95	282
	Cost of Liming operation	4229	6575	2186	6998	6338	2862	3038	9022
Prescription lime application based on pH mapping (includes cost of mapping)	**Area requiring liming (ha)**	51	61	16	47	73	21	26	102
	Tonnes Lime required (t)	82	85	15	40	148	18	28	147
	Cost of Liming operation	3266	3709	1302	2319	5697	1005	1350	6059
Cost savings by mapping ($)		$963	$2866	$884	$4679	$641	$1857	$1688	$2962
% saving on cost of lime operation compared to Uniform rate 2.5 t/ha		23%	44%	40%	67%	10%	65%	56%	33%

8.3 APPENDIX 3. Participant feedback

16 Workshop attendees
12 FASC Participants; 4 "other" Acid Soils champions, 4 FASC non -attendee
(2 apologies, 2 no response) **Feedback forms returned:** **16** (100%)

Workshop content	None	Little	Some	Very	Total
How relevant to business	0	0	1	15	16
How interesting	0	0	2	14	16

Value of Workshop Content	N/A	None	Little	Some	Very	Total
Workshop 1. Overview of acidity	1			2	13	16
Workshop 1. Field Kit pH mapping exercise	2	1	1	7	5	16
Paddock activity 1. pH mapping using field kit	3	1	1	4	7	16
Paddock activity 2. pH mapping using Veris pH machine	0	0	0	0	16	16
Site Report	2	0	0	3	11	16
Workshop 2. Overview of pH mapping		0	0	3	13	16
Workshop 2. Overview of LEP pH mapping results.	0	0	1	2	13	16
Workshop 2. Acidification model and lime comparison	0	0	1	6	9	16

What did you learn that was new?
Ways to counter pH decline
All paddocks will eventually acidify if continuously cropped with N fertiliser and no lime
All in the same boat when it comes to surface acidity
Nitrogen leaching rates in different soil types
Soil acidity - worse that we first thought
Increased understanding of acidification rates under different crops and fertiliser strategies.
High variability in pH even within the same paddock
How easy it is to lime to address surface acidity
Managing subsurface pH is just as important as managing surface acidity
Better understanding of the impact of lime on the soil
Economics of pH mapping compared to uniform lime application rates
Reinforced where we thought we were at
Ease of getting pH maps done.
Different lime types/sources in South Australia

Will you be implementing changes as a result of program	No	Maybe	Probably	Yes	Total
# participants	1	0	3	12	16

What areas of the program could be improved?
More trials - around how quickly lime moves through the soil profile/yield decline at different pH levels.
Field trip to acidic paddock/lime trial
Timing of night meeting did not suit those with young families
Good program/No improvements suggested x 3
Correlate pH decline to yield decline to show farmers value of liming

Lime history	N/A	0%	1-20%	21-40%	41-60%	61-80%	81-100%	# particpants
What proportion of your farm do you think is acidic?	0	0	2	2	6	3	3	16
What proportion of your farm do you intend to lime over the next 5 years?	0	0	6	3	2	3	2	16

Area mapped and limed this season	N/A	0 ha	1-50 ha	50-99 ha	100-199 ha	200-299 ha	>300 ha	# participants
How much liming have you undertaken this year? (ha)	3	3	1	1	3	3	2	16
How many ha did you have mapped with machine? (ha)	3	0	1	5	4		3	16
How much mapping using field kit/soil tests? (ha)	3	2	2	5		2	2	16

Reasons For Increased Liming
No lime so far but increased understanding of issue will result in increased future spreading
More labour for spreading
Seen improved growth/weed control where have applied lime
Change in crop production, particularly where Al toxicity has been an issue

Soil testing	N/A	Never	Occasionally	Regularly	Total
Soil testing to map soil pH	1	2	8	5	16
Soil testing to manage nutrition	1	0	10	5	16

Management techniques tried	N/A	No	Yes (Unsuccessful)	Yes (Successful)	Total
Surface liming to manage acidic soils	1	4	0	11	16
Deep incorporation of lime	1	10	0	5	16
Yield mapping to identify zones	1	3	1	11	16
EM38 Mapping to identify constraints	1	9	2	4	16
Managing production zones	1	5		10	16
Other					

Management techniques likely to implement	N/A	No	Maybe	Yes	Total
Soil testing to map soil pH	0	0	1	15	16
Surface liming to manage acidic soils	0	0	1	15	16
Deep incorporation of lime	0	4	8	4	16
paddock scale pH mapping	0	0	0	16	16
Other	gamma radiometric mapping				

Further work required
Subsoil pH testing
Aluminium toxicity and minimum pH for production
Deep incorporation of lime for addressing subsurface pH
pH mapping is a great tool
Impact of historical farming practices on acidification of paddocks.
Reclaiming saline land
Managing subsurface acidity.
Addressing compacted subsurface layers.