COGGO Council of Grain Grower Organisations Limited ACN 091 122 039	**Final Report** **COGGO Research Fund for 2016 projects** **A project completion report covering the project. The acceptance of a satisfactory report against the objectives of the project, and agreement on the sharing of any commercial returns and/or IP will trigger payment within 4 weeks, by COGGO for any outstanding payments.**

This Final Report should be completed with reference to the Research and Intellectual Property Agreement (the Research Agreement) signed between the proponent and COGGO Pty Ltd.

1. Project information

Project title	**Demonstration that sampling the soil profile leads to better soil acidity management**
Commencement Date	1 January 2016
Completion Date	31 December 2017

Name of Proponent	SoilTech Research	
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Project Number	
Date Received	

2. Project results	This section provides a final report against the Project Aim and the Planned Outputs for the Project.

Achievement of the Project Aim	Brief statement of achievement in relation to the aim of the project

Subsoil acidity costs farmers an average of $141/ha/year in lost productivity at a total cost to the Western Australian grains sector of $1.6billion/year (Petersen 2015). Most growers understand the impact of subsurface acidity on yield, and lime use across rural WA has been steadily increasing, but is still only about 40% the annual DAFWA suggested requirement is applied in any given season.

This project aims to document the impact of the way different growers have been managing soil acidity. The hypothesis is those provided with a better understanding of their soil pH profile and a detailed 10 year liming recommendations that adopted the approach will have better acidity status now than those that either have not sampled to depth, or did not apply suggested lime applications. We expect to show knowledge of soil pH to depth is critical in managing acidity, irrespective of the scale (individual farm, regional area or statewide).

Thus, the focus is on 'resampling previously sampled locations', and correlating the pH change over time, with the amounts of lime applied during that period. We propose to evaluate pH change over a 5 to 10 year time frame. For farmers willing to share detailed records of their lime inputs over this period, all project funds sought will be allocated as a subsidy for sampling and pH measurement. We aim to adopt the same strategy that worked well in the initial 'awareness' raising programs previously conducted by DAFWA and Precision SoilTech- the grower pays for the topsoil collection; the project funds cover the deeper sample collection and pH measurement.

Project Outputs		Please provide a report on the achievement, or otherwise, of the project outputs as per the planned outputs provided in the Project Proposal.
1	-	The key to this approach is to eliminate the normal 'lag' that exists. By resampling historic geo-referenced soil sampling locations, soil pH r five to ten years ago (T0) and current (T1) soil pH and soil pH change (TΔ) can be documented and linked to total lime applications over the period
		With the large data base of growers and geo located soil sampling locations from across WA managed by Precision SoilTech, we successfully identified 90 growers to participate in the project. We had aimed at getting 100 growers, but missed the final few for a range of reasons. We successfully sampled growers that had been sampling to depth over many years and for those new to sampling deeper in the soil profile. These two groups were termed "new' and "old' samplers, in reference to the time frame they had looked below the soil surface. We were able to sample growers from across the state, and able to show some clear differences in the pH distribution (Figure 1)
2	-	Proof growers that adopt sound liming strategies, based upon profile pH and strong scientific evidence have soil profiles in better condition than those that do not sample to depth, or do not apply lime recommended
		The data collected does not necessarily imply 'proof' the growers sampling to depth are managing acidity better than their counterparts that only sample surface soils. Our summarized data does however provide a very strong indication growers that sample to depth are managing subsurface acidity better than their colleagues that only sample surface soils. We are trying to look at ways of collecting more data over a much larger zone of WA to explore this management strategy. Current logic suggests investing more in soil sampling is a critical and important strategy to manage subsoil acidity. Understanding subsurface pH influenced grower's management of soil acidity- and there was significant difference in 'new' (to depth) and 'old 'growers in terms of the lime applied. "Old' samplers are currently applying 50% more lime than their colleagues that are 'new' to subsurface sampling (Figure 2.) This is a very dramatic difference, and ongoing extension of the importance to understand subsurface pH should continue for the benefit of WA agriculture

3	-	Regional comparison data. For example, is soil pH in the Northern Ag region in better condition that the eastern wheatbelt or the Upper Great Southern? Why? Is proximity to better lime sources a factor? Is adopting advice a factor? Do farmers in all regions adopt liming in the same manner?
		The data collected in this project indicates there are substantial differences in the way growers are managing soil acidity in different regions of WA (Figure 3). Far less surface soils (0-0cm) in the Northern Ag region are under DPRID targets compared to the central and southern regions. Several factors are likely to be contributing. Proximity to high NV, fine particle size lime for growers in the Northern ag region compared to the growers in the southern region is considered to be the major influence in this difference (Figure 3).

Project results	1. Key discovery The farmers sampled within this COGGO project that sample deeper into the soil profile are currently using 50% more lime each season than growers that just sample the surface soil. This supports the rationale behind the project- encouraging growers to sample to depth improves their management of soil acidity, especially subsoil acidity, which is an ongoing process for many. We previously had indications of the value in sampling to depth, but the confirmation across the state was very convincing. Although this finding was predictable, the magnitude of the additional lime being applied when growers have identified subsoil acidity was greater than expected. There are important implications from both a resource management perspective, and the wider WA economy from this data. Many soils in WA are acidic at depth. To manage this issue, growers need to understand where the problem is, and then apply adequate lime to deal with the issue. It is repairable, but knowledge of the extent and severity is critical. Given annual lime use is still only circa 40% of what DPIRD suggests needs to be applied annually, ongoing extension would seem to be a logical investment. Further, given the apparent differences in different locations of the state (the south is far more acidic than the north), targeted regional activity would seem sensible. 2. Application to WA Grains Industry The implications of sampling to depth are very significant for the WA grains Industry. Subsoil acidity is extensive across the WA grain belt, and is annually limits production and economic growth of the wider WA economy. Most growers sample surface soils for fertiliser inputs. With specialist soil sampling operations now, that have the capacity to sample deeper in distinct layers, there is very limited need to 'change', which farmers often resist. The only issue to better target lime requirements is the few additional dollars spent on sampling deeper, and measuring soil pH. This process should be strongly encouraged. One of the issues is the dominance of the fertiliser companies in driving soil sampling, which is largely focused on fertiliser sales, and hence dominated by simply surface soil sampling. A good example of the situation can be understood by viewing the website of a very major fertiliser supplier. There is reference to deeper soil sampling, however rather strangely, the limitations of acidity is not even mentioned. That process may have been valid 50 to 60 years ago, when there was an identified need to build inherent soil fertility (N, P, K and S) across the state. That process worked well, and farmers applied the nutrients needed. There has however, been far less lime applied than required, hence the extent and severity of subsoil acidity across the state. To address this, systems need to adapt, and subsoil sampling is a very simple strategy to enable this to happen. 3. Economic benefit to WA Grains Industry With subsurface acidity shown to be an extensive problem across WA, and evidence it is costing the WA economy circa 1.6 billion dollars per annum, it seems very compelling for growers to better manage the issue. The process is relatively straightforward- (a) identify the soils most impacted by profile sampling (b) apply the required lime, and ideally incorporate it for a more rapid reaction, then (c) re measure pH to monitor progress, applying additional lime where required. Clearly, there are considerable costs involved, especially given lime is generally a coastal resource, and it need to travel large distances to be applied. The evidence however is very compelling- the problem is costing growers massively each year, and it can be rectified with intervention. Without inputs, it will not get better, and every year without remediation, further economic loss occurs.

4. Difficulties Encountered

A couple of minor issues were encountered during this project. Firstly, a couple of staff changes. This caused some minor difficulties with recruiting and training replacement staff, and it delayed our capacity to deliver within the expected time.

Having farmers involved cooperate by supplying data required to interpret findings was the major issue. For many, they don't see the value making time to provide the information. For others, their record keeping is simply to complicated. For others, the concept of 'subsidized sampling' is simply just for their benefit without obligation, to share information for the benefit of others.

We conclude the best approach going forward with this type 'co-investment project' is to simply charge commercial rates for service up front, and if, and only when growers supply the necessary data, does the commercial partner rebate the applicable funds provided by the project.

5. Conclusions reached

We have been able to demonstrate growers that sample deeper in the soil profile gain useful knowledge of subsoil acidity, and as a consequence they are applying more lime, to manage the limitation.

Demonstrating to farmers to make measurements, then act on knowledge by applying lime where required, then to monitor their progress (by re testing soils after a reasonable time frame) is a simple and logical approach to better manage soils from both a productivity and sustainability perspective.

The fact we can show substantial differences in annual lime between the growers in terms of those that sample to depth, and those that are new to the concept highlights there is still considerable need to maintain targeted extension on soil management.

6. Recommendations going forward

Soil acidity management on WA grain farms is less than optimal, and this is costing the WA economy significantly each year. Subsoil acidity can be managed, and this is best achieved by soil sampling in the first instance. It is critical for growers to sample to depth- this information enables industry professional to tailor lime inputs to where it is required

With soil sampling dominated by fertiliser companies, there would seem to be value in encouraging the field staff to sample to depth. This regime may not influence fertiliser sales (and therefore could meet with some resistance), however for profitable and sustainable farming, it would seem highly necessary.

3. Project resources	This section describes use of the funding listed in the initial plan and any refunds due to COGGO

Expenditure of funds requested from COGGO	$ Total funds budgeted	$ Total funds expended (actual)	$ Total funds requested from COGGO*	$ Total COGGO funds expended	$ Refund due to COGGO of any unexpended COGGO funds
Salary/Contractors	0	0	0	0	0
Operating costs	92,400	89,351	92,400	89,351	3,049
Capital	0	0	0	0	0
TOTAL	92,400	89,351	92,400	89,351	3,049

*Funding provided by COGGO.

IMPORTANT: Return of unused funds to COGGO is required as per *Clause 3.3* of the Research Agreement.

4. Commercialisation	There is no commercial output from this project. Data collected is made publically available, without specifically identifying project participants.

5. Communication/ Extension	The findings from this project are very much in line with the predicted situation, which was a driving force in the initial application (i.e. to document if subsoil acidity management can be enhanced by encouraging more growers to sample to depth. We are tackling communication on two main strategies. Firstly, direct with growers, secondly on communicating outcomes to colleagues involved in agriculture across WA, in a concept we term 'train the trainers'. Our rationale, if we can make the process simple and transferable amongst industry professionals, we can assist more people in the long terms. The clear focus is improving the profitability on managing subsoil acidity in Western Australia. Our communication strategy is to builds overall momentum and generate enough of a critical mass of people talking about identifying and subsequently managing subsoil acidity, and with this, we believe we can attain the required break through.

6. Certification

The Project Supervisor and the Research Organisation certify that all information contained in, and forming part of, this final project report is complete and accurate. The project supervisor and research organisation further warrant that the project complied with all the relevant guidelines affecting the conduct of research, for example in relation to ethics, bio-safety, environmental legislation, GMAC or National Health and Medical Research Council Codes.

Project Supervisor's signature _____

Name (in Capitals) STEPHEN CARR

_____ Date:

Research Organisation signature _____

Name and title of authorised signatory (in Capitals) DR STEPHEN CARR

_____Date:

Completed Final Project reports

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COGGO representative

For the purpose of this Project agreement contract, COGGO will be represented by Grains Industry Association of Western Australia (GIWA), or such other representative that is nominated by COGGO as authorised to operate on behalf of COGGO.

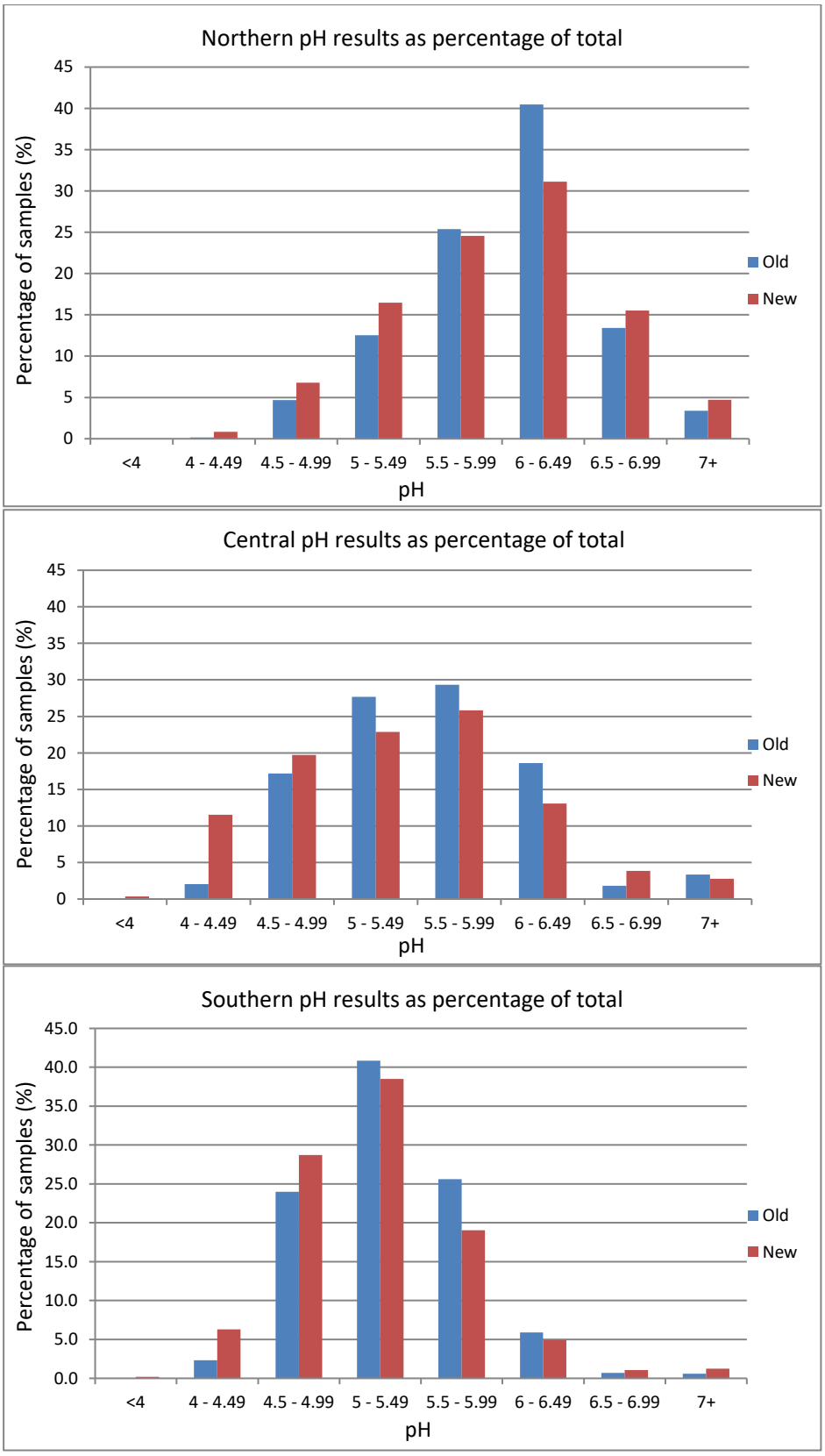

Figure 1a Topsoil pH (0 -10 cm) pH distribution in three regions of WA

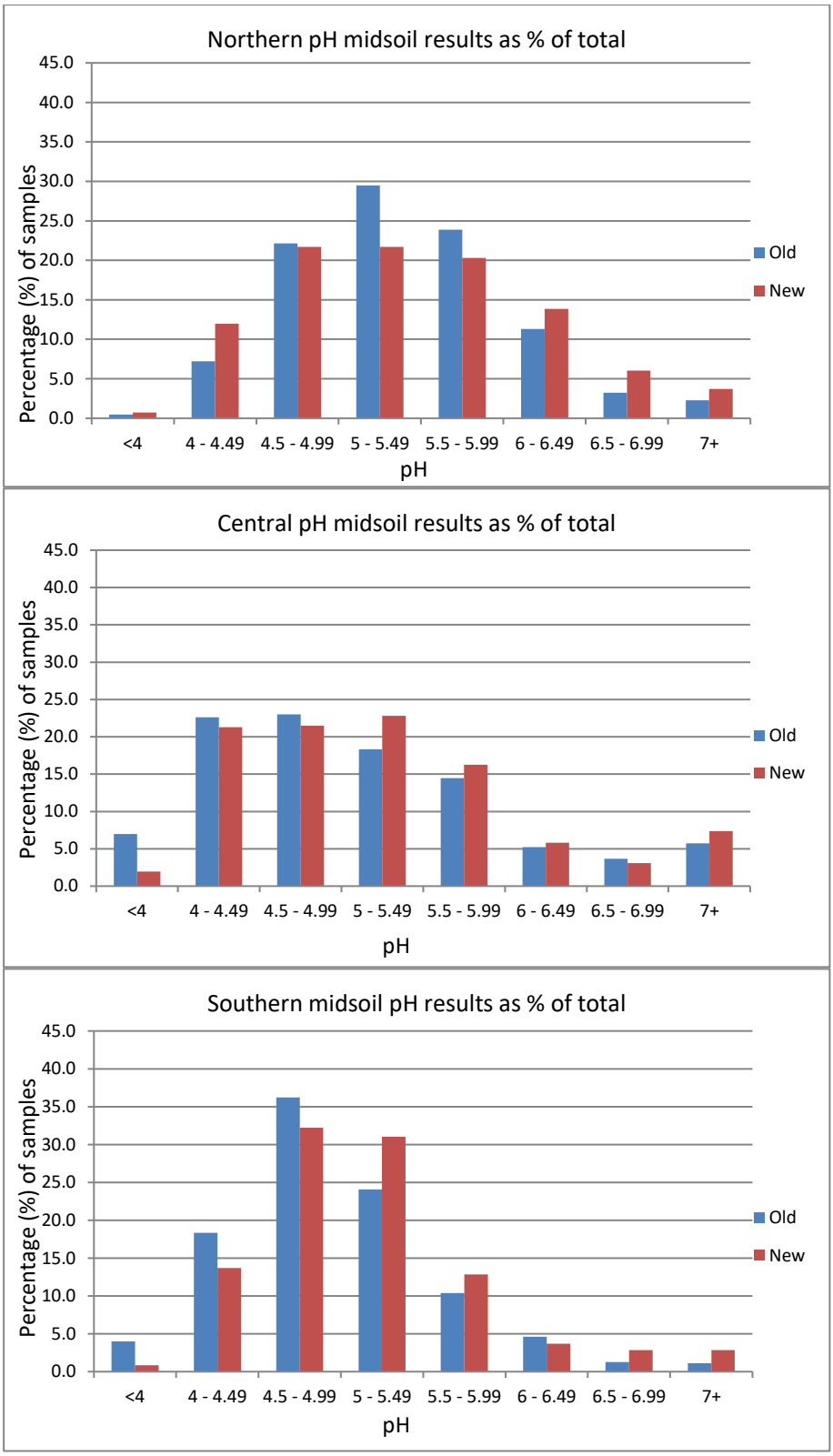

Figure 1b Midsoil pH (10-20 cm) pH distribution in three regions of WA

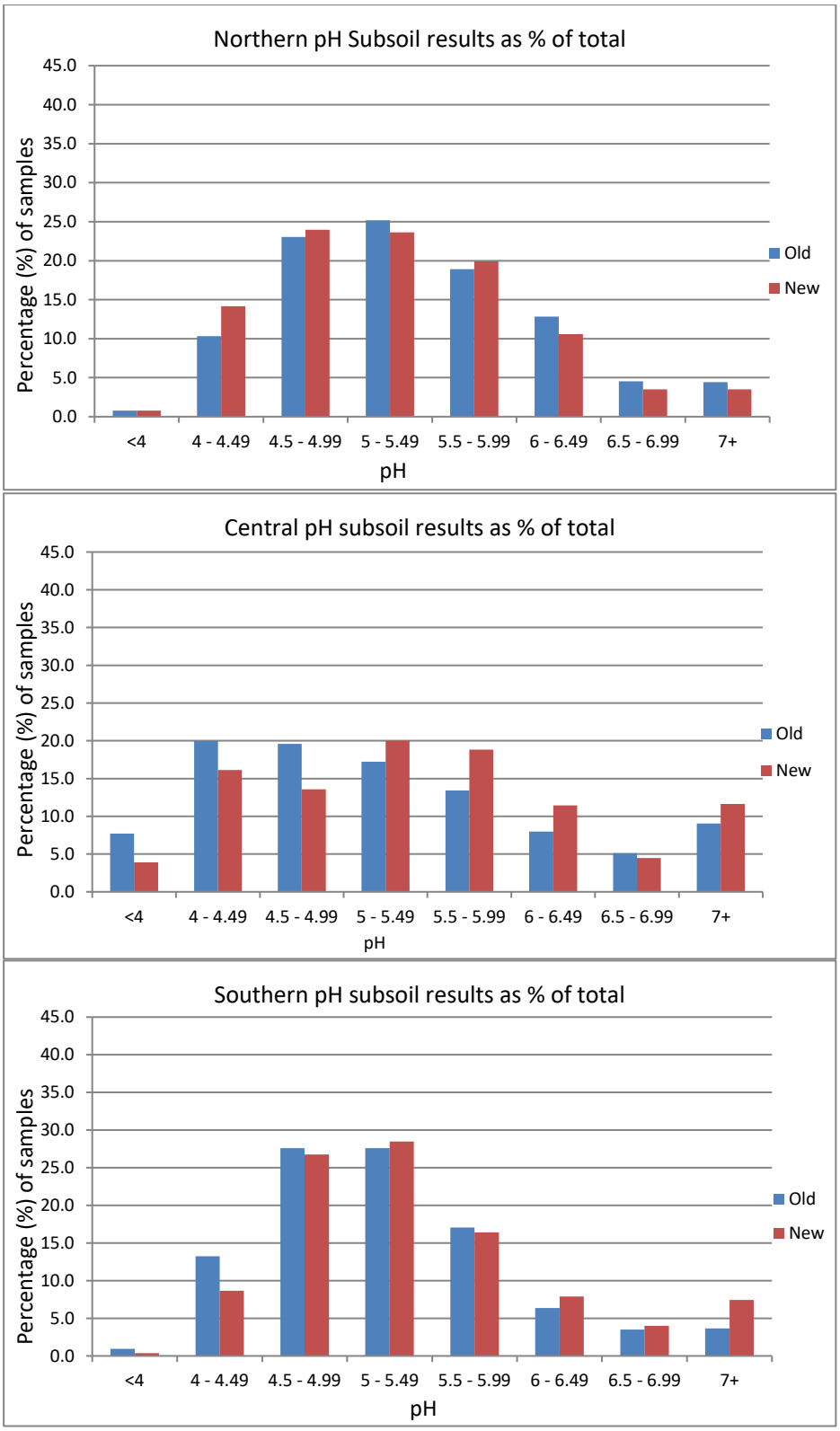

Figure 1c. Subsoil (20 -30 cm) pH distribution in three regions of WA

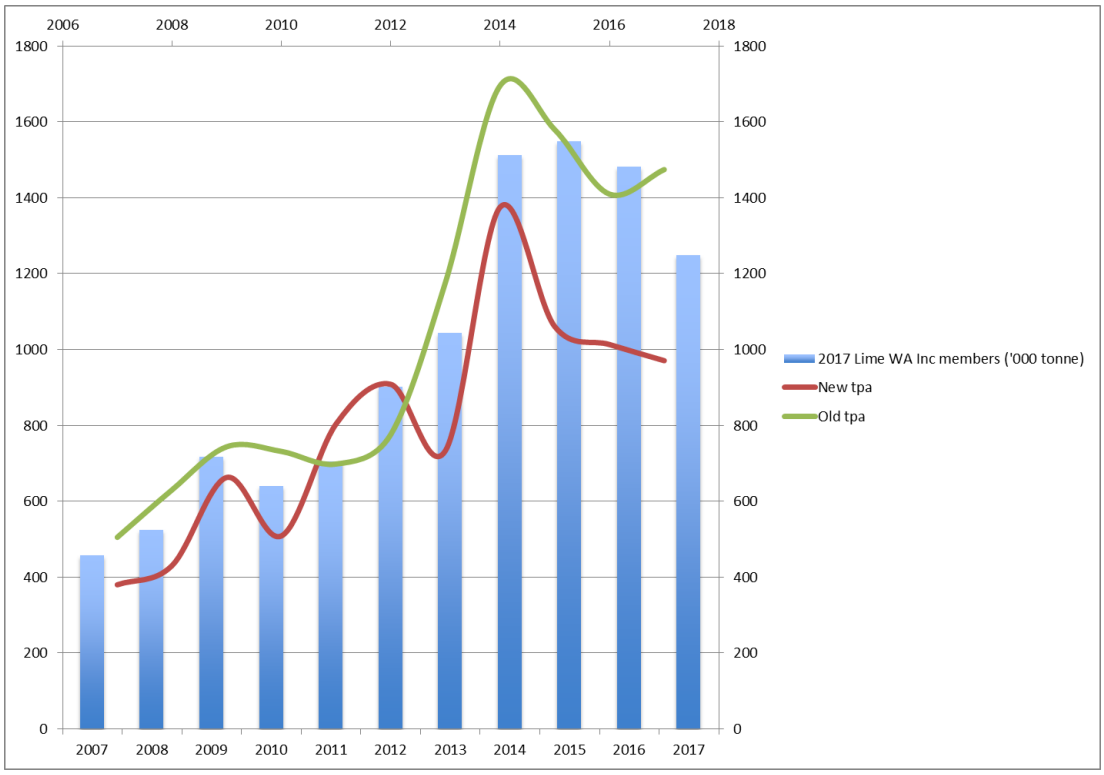

Figure 2. Lime use of 'old' soil samplers (in this context, been sampling to depth for over 10 years) compared to colleagues that are 'new' to sampling to depth. Overlaid with total lime applied in WA (note scale difference- LH axis is thousands of tones per annum. RH axis tonnes per annum

Issue to note:

1. Old samplers were applying 20% more lime 10 years ago. This is now 50% more per annum

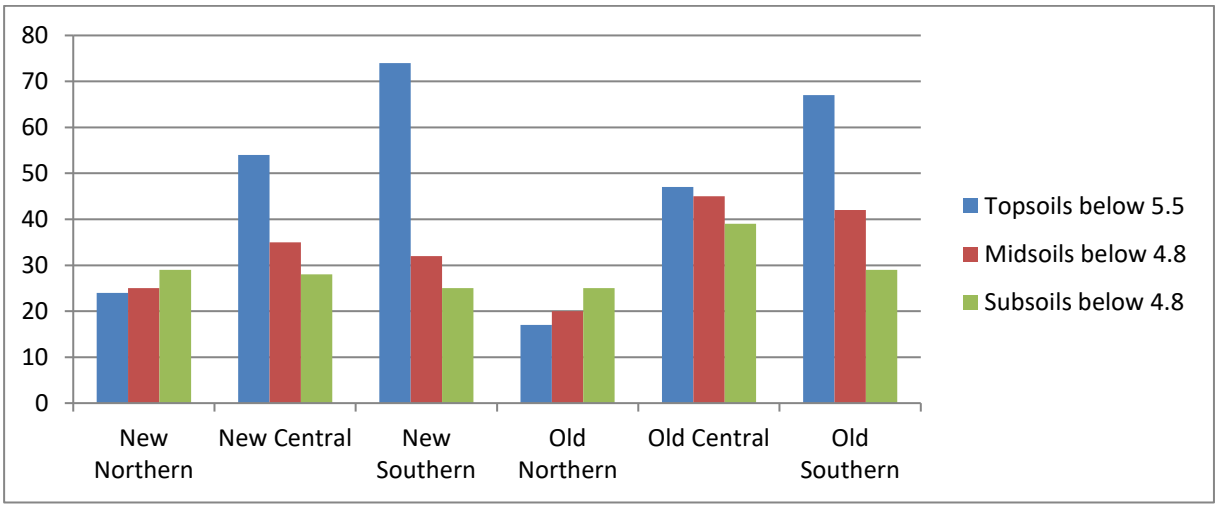

Figure 3. Differences in the proportion of soil samples below DPRID target pH differs across the WA wheatbelt.

PROJECT SYNOPSIS SUITABLE FOR GENERAL PUBLICITY AND COGGO WEBSITE

There has been considerable effort to demonstrate the extent and severity of subsoil acidity in WA, which is a widespread problem. Having growers understand the magnitude of problem has facilitated management intervention.

Most growers do now understand the impact of subsurface acidity on yield, and lime use across rural WA has been steadily increasing, but is still only about 40% the annual DPIRDA suggested requirement is applied in any given season.

Despite the better knowledge of growers, and the increased lime use, subsoil acidity is still costing farmers an average of $141/ha/year in lost productivity at a total cost to the Western Australian grains sector of $1.6billion/year (Petersen 2015). These annual losses are very significant in terms of grower profitability and the wider WA economy. More lime use is required

This project build upon past research which has been very successful in proving soil acidity can be managed with adequate lime application. In simple terms, the concept of a measure, manage-monitor regime is advocated as best practice. First step is identifying the depth of the limiting soil depth in terms of pH, secondly, applying adequate lime to repair the process, and re measuring again to monitor progress and repeat as required.

In this project, we again demonstrated there is enormous value in 'cost sharing' between researcher and grower in this type of awareness project. By co contributing, growers gain, funding organizations gain, and more data can be collected with available funds, which provide better evidence.

We have shown, in growers across the WA wheatbelt, that those with a with a better understanding of their soil pH profile, provided a detailed 10 year liming recommendation are applying 50% more lime to their farms than their counterparts that just measure surface soil pH.

We have also demonstrated the value in geo locating soil sampling locations to monitor change over time is a valuable component of the farmer's soil management regime.

Our data suggests concerning trends within broadly designated zones of the WA wheatbelt (North, Central and Southern) in terms of growers maintaining soil pH above DPIRD recommendations. We speculate the combination of growers sampling to depth and the proximity to high quality lime sources is having a measureable and profound impact. There would seem to be significant value in trying to develop options to get growers in the southern and central regions to better accept the impact of subsoil acidity. They have a great deal of work to get on top of the situation, with 70% and 50% of surface samples respectively still below DPIRD target. Until the surface pH is dealt with, the chance to manage subsoil acidity is extremely limited.