Office Use Only	
Project Code	
Project Type	

FINAL REPORT 2016

Applicants must read the *SAGIT Project Funding Guidelines 2016* prior to completing this form. These guidelines can be downloaded from www.sagit.com.au

Final reports must be emailed to admin@sagit.com.au as a Microsoft Word document in the format shown ***within 2 months*** after the completion of the Project Term.

PROJECT CODE	:	**ELD215**

PROJECT TITLE (10 words maximum)
Quantifying productivity and profitability gains with liquid injection systems on clayed sands

PROJECT DURATION

*These dates **must** be the same as those stated in the Funding Agreement*

Project Start date	**2015**
Project End date	**2015**

PROJECT SUPERVISOR CONTACT DETAILS

The project supervisor is the person responsible for the overall project

Title:	**First Name:**	**Surname:**
Mr	Adam	Hancock
Organisation:		
Elders Rural Services		
Mailing address:		

Telephone:	**Facsimile:**	**Mobile:**	**Email:**

ADMINISTRATION CONTACT DETAILS

The Administration Contact is the person responsible for all administrative matters relating to the project

Title:	**First Name:**	**Surname:**
Mr	Adam	Hancock
Organisation:		
Elders Rural Services		
Mailing address:		

Telephone:	**Facsimile:**	**Mobile:**	**Email:**

PROJECT REPORT

Provide clear description of the following:

Executive Summary

Liquid injection applications of phosphorus were applied to wheat on clayed sand north of Bordertown with lower rates of granular P to assess the agronomic performance and cost benefit. Performance of liquid injected copper was also assessed. All results of grain yield were not significant (NS).

Treatments

1) Nil P
2) 8kg granular P
3) 16kg granular P
4) 16kg granular P + 2.5kg Liquid P
5) 8kg granular P + 2.5kg Liquid

- The average of treatments with P yielded 0.09t/ha more than the untreated.
- The greatest difference in yield was 0.11t/ha with the lowest yielding being the untreated with all results being not significant, potentially demonstrating that lowering granular P rates below the point of achieving even distribution along 10" rows and supporting with liquid P prevents reduced yield.
- Colwell P tests averaged 16.5 (PBI 20), BFD Calculator concerning this soil type suggested Colwell 20 to achieve 95% of maximum yield ranging from 15-26, a NS result demonstrated BFDC accuracy.
- Soil Copper DTPA averaged .24, tissue test results at GS22 was 4.5 mg/kg and there was a NS result between treatments, Copper treatments increased grain Cu mg/kg by 1.1 mg/kg.
- NDVI taken at time of tissue testing (GS22) correlated with P% more than any other nutrient. Canopy Camera SAVI_green did not correlate with any analyte.

Project Objectives

The aim of this project was to investigate agronomic and profitability gains with liquid injection systems on clayed sands using replicated trial design. The trial was designed to test the theory that reducing the rate of granular P fertiliser below attaining even distribution along the seed row could be achieved without yield penalty using a liquid injection system applying a small amount of starter phosphorus to supply to plant for the first 6 weeks.

The main objectives are then:

A) Assess if the site is phosphorus responsive
B) Assess the response using liquid injection phosphorus
C) Assess response of copper applied using injection below seed

Overall Performance

The overall objectives of the project were achieved successfully managing a replicated trial site albeit with no statistical significance.

Main issues:

- The chosen site location north of Bordertown experienced well below average rain, particularly in spring, having a total 186mm of GSR, with the three nearest weather stations ranging from 100-125mm below avg. The site experienced six days above 35-38°C during flowering with 45% of days in Oct being above 30°C, the nearby NVT site (Sherwood) recorded twelve days below 0°C between mid Sept – mid Oct during flowering, surrounding areas were cut for hay.

- Site selection, despite all efforts, was potentially a liability as the replicated trail site stretching east moved up the hill, some of the treatments were more exposed to poorer soil type than others, mostly the treatments receiving higher inputs which yielded unusually less than the untreated, see table 1.

Table 1 Grain yield of each individual plot

	West			
South	1.86	2.21	1.89	1.58
	1.84	2.29	2.02	1.79
	1.79	2.23	1.93	2.02
	1.58	2.24	1.94	1.89
	1.71	2.3	2.03	1.87
	1.64	2.28	1.98	1.56
	1.91	2.11	1.96	1.64
	1.68	2.1	2.04	1.63
	2.15	2.08	2.12	1.8
	1.97	2.03	2.06	1.77
	1.77	2.05	1.95	1.8
	1.89	1.79	1.81	1.89
	Sand Hill			

The results of the phosphorus component of the trial showed visual differences in biomass from an early growth stage, as measured by the NDVI, with increased biomass with increased P fertiliser, but none of the phosphorus treatments were able to statistically increase yield over the untreated. This could be due to the limiting rainfall or perhaps the soil profile having a Colwell of 16.5 at 0cm-10cm and Colwell 8 at 10cm-40cm being adequate for grain yield. P treatments did create an increase in tissue test results at GS22 with the untreated having 0.44mg/kg P and an average of all treated having 0.58mg/kg P with little variance between the treated, this showed that applying a lower rate of granular P with liquid P maintained a higher test result. The grain analysis showed that the 0kg/ha phosphorus treatment had a higher grain phosphorus percent at 0.33% whilst the average of the treatments with phosphorus applications was 0.27%. Test weights, screenings and protein were all tested and were not significantly different. No other significant observations including tiller counts, stem thickness, frost damage or visual symptoms were noticed between treatments.

Better Fertiliser Decisions Calculator (BFDC) was used to determine a likely response from phosphorus using the colwell test result. BFDC is a national database of available soil test-crop response calibration trials undertaken to assess the nitrogen, phosphorus, potassium and sulphur status of soils used for the production of cereal, pulse and oilseed crops.

The trail site soil characteristics was identified as a Tenosol, the result suggested a range of 70% confidence limit at 90% Relative Yield with a colwell 16.0 (14.0 - 18.0), soil test results averaged 16.5 colwell.

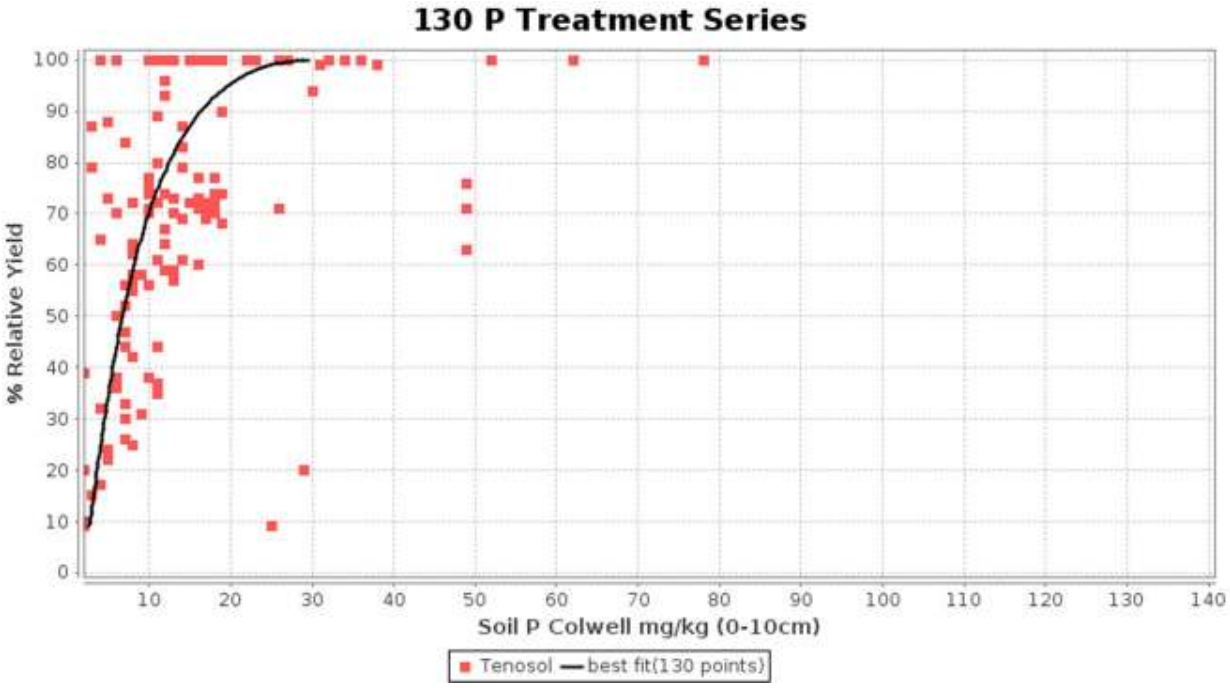


Figure 1 BFDC response curve for wheat on Tenosol.

The copper response component was a small opportunity trial to assess the response of copper on clayed sands north of Bordertown, copper soil DTPA was 0.28, tissue test results @ GS22 ranged from 4.4mg/kg to 4.8mg/kg and the grain analyses on untreated copper was 1.3mg/kg, all three analyses are marginally greater than the minimum critical range according to the Reuter Robinson interpretation manual and a slight increase in yield was achieved but was not statistically significant.

Co-operators of the project:
Staff of Kalyx Australia, Nic Amos
Staff of Spraygro Liquid Fertilisers, Brett Kearsley

Key Performance Indicators (KPI)

KPI	*Achieved (Y/N)*	*If not achieved, please state reason.*
Establish small plot trail on active cropping ground on clayed sand.	**Y**	Kalyx Aust managed to install a liquid injection system on a small plot seeder achieving 80L/ha of total solution as a constant stream placed below the seed. Site location was placed on cropping ground to capture the real potential benefit.
Trial site extension day	**Y x 2**	
Discussion of results at local AgBureau's	**Y**	At time of writing there were still some discussion nights remaining.
Report/graph economics of data	**Y**	

Technical Information

Table 2 Phosphorus treatments application and response

Treatment	Applied	Rate	Method	Yield t/ha	Grain P %	HLW	Screenings	Protein	Tiller Count GS30
0kg P	Stimulus	85kg/ha	Topped	1.88 a	0.33	73.4 a	6.6 a	11.4 c	372.8 a
8kg P	Stimulus Croplift19	40kg/ha 65kg/ha	Topped Banded	1.98 a	0.29	73.8 a	5.5 a	11.4 c	372.5 a
16kg P	Croplift19	130kg/ha	Banded	1.99 a	0.24	73.3 a	5.8 a	11.9 ab	380 a
16kg P + 2kg Liquid P	Croplift19 Liquid P	130kg/ha 20L/ha	Banded Banded	1.91 a		73.7 a	6.3 a	12.1 a	385.5 a
8kg P + 2kg Liquid P	Croplift19 Liquid P	65kg/ha 20L/ha	Banded Banded	1.98 a	0.24	74.6 a	5.7 a	11.4 bc	380 a
LSD P =.05 CV				0.361 12.31	NA	1.71 1.62	1.42 15.47	.45 2.68	23.15 4.1

Figure 1 shows test results demonstrating that the closest correlation was between NDVI taken at time of tissue testing and the P%, this relationship had a correlation coeffiency of .61

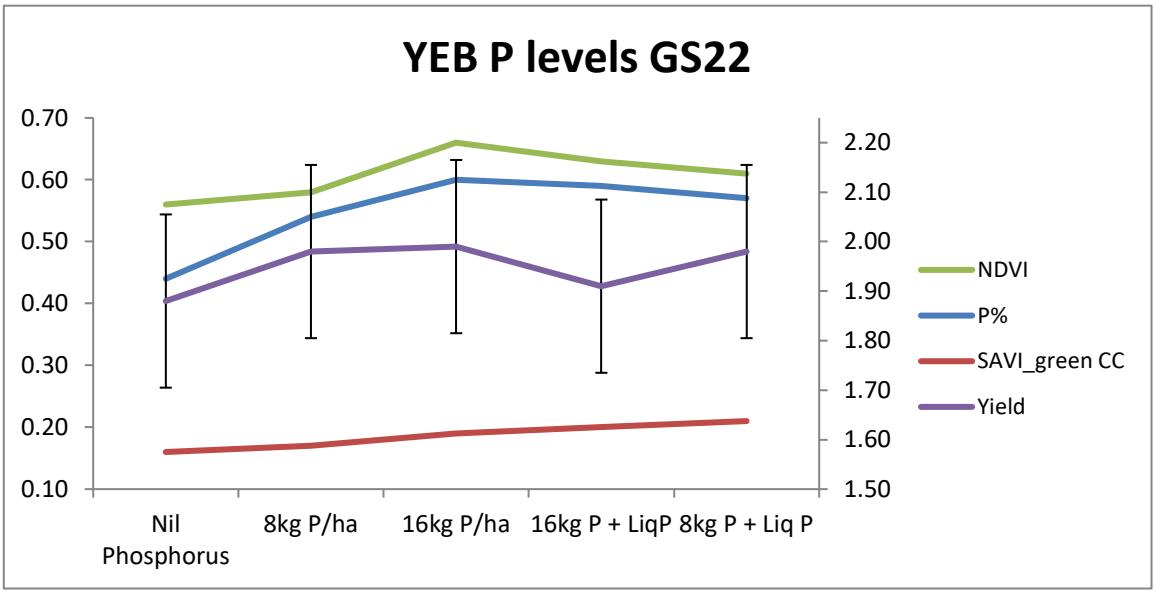


Figure 2 NDVI and P% Correlation 0.7860, error bars show LSD on yield

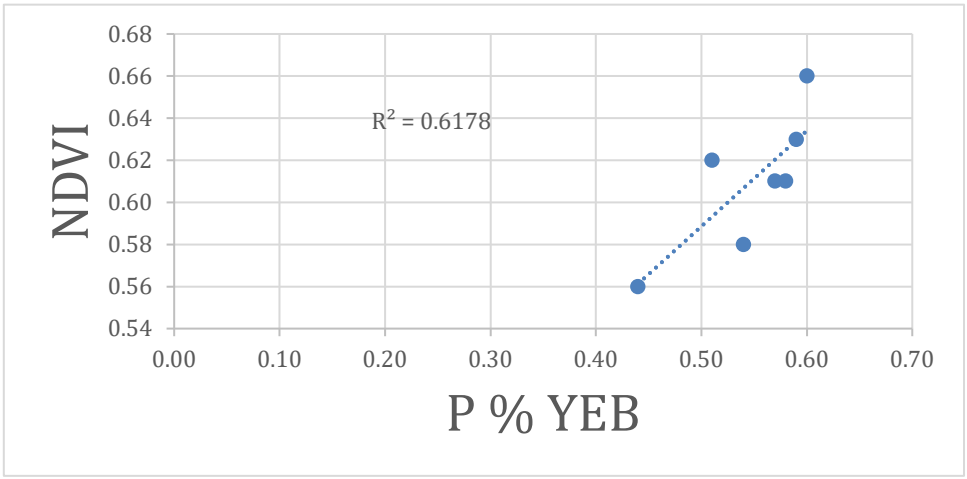


Figure 3 Correlation between NDVI and P%

Pictures 1 and 2 showing nitrogen deficiently like symptoms appearing much earlier on treatments with zinc, manganese and copper applied up front liquid injection.

Picture 1 Treatment with Zinc, Mang and copper liquid injection

Picture 2 Treatment with no Zinc, Mang and Copper applied liquid injection

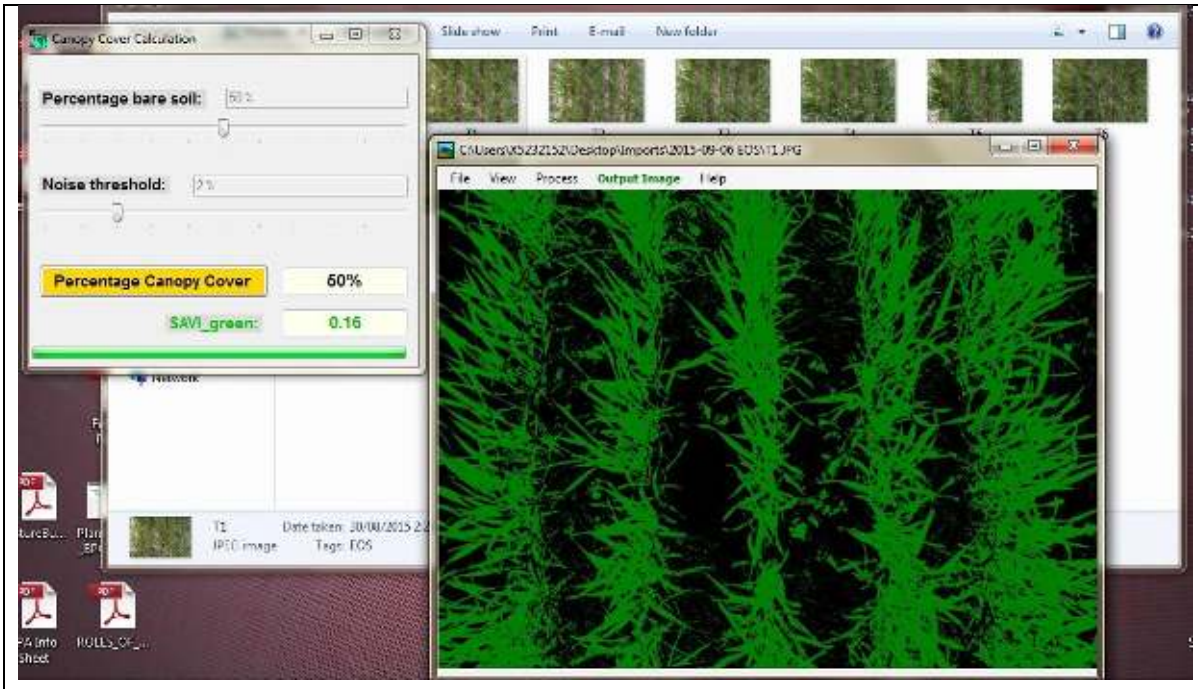


Figure 4 Canopy Camera using a Cannon EOS 450 at 35mm 1 meter high

	NDVI	*SAVI_green CC*	*Yield*	*Tiller Count GS30*
NDVI	1			
SAVI_green CC	0.687645	1		
Yield	0.479881	0.402684944	1	
Tiller Count GS30	0.774857	0.8407412	0.03707	1

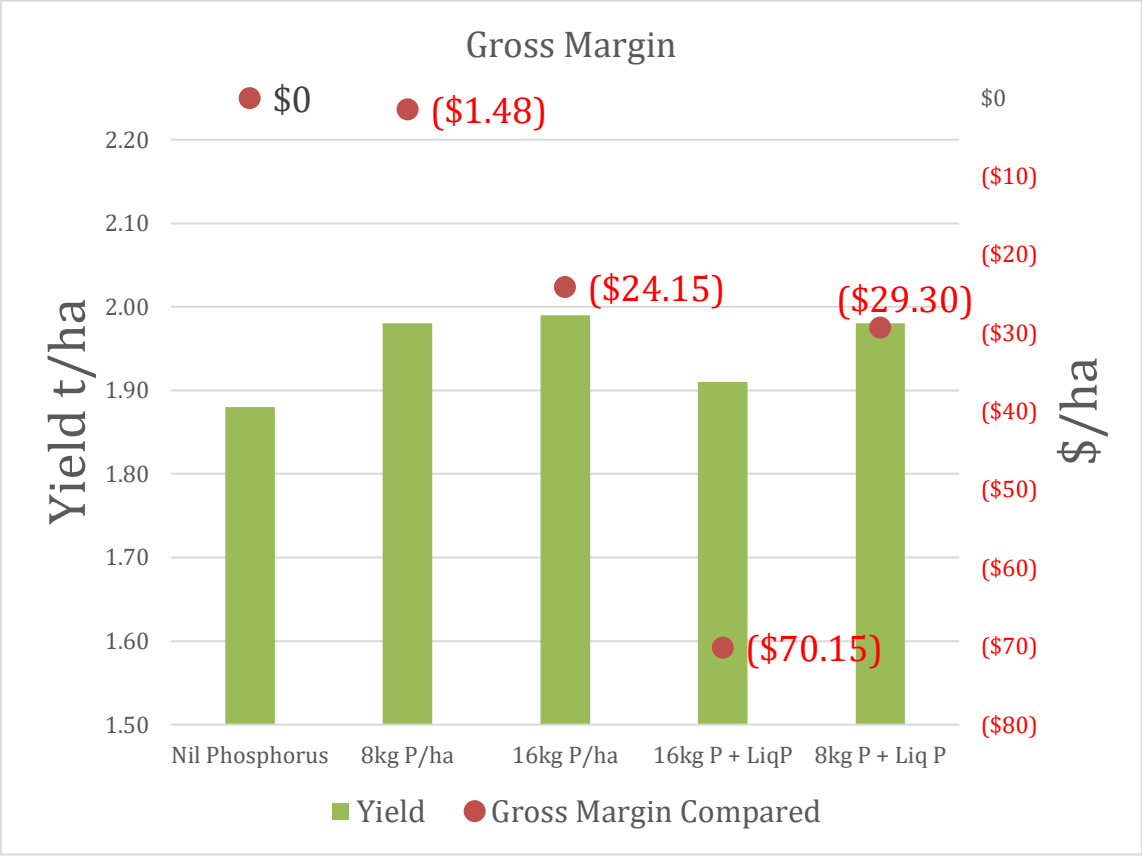
Copper Response:

Table 3 Raw data from Copper response trial

Treatment	Applied	Rate	Method	Yield	Grain Cu	HLW	Screenings	Protein
No Copper	Croplift 19 Zinc Manganese	135kg/ha 500g/ha 500g/ha	Banded Injection Injection	1.86 a	1.3 mg/kg	72.5 a	6.5 a	12.1 a
Injection Copper	Croplift 19 Copper Manganese Zinc	135kg/ha 250g/ha 500g/ha 500g/ha	Banded Injection Injection Injection	1.91 a		71.7 a	7.3 a	12.1 a
Injection + Foliar x 2	Croplift 19 Copper Manganese Zinc Copper EDTA Copper	135kg/ha 250g/ha 500g/ha 500g/ha 75g/ha 75g/ha	Banded Injection Injection Injection Foliar GS22 Foliar GS45	2.04 a	2.4 mg/kg	74.1 a	6.2 a	11.8 a
LSD P=.05 CV				.325 10.49	NA	1.71 1.62	1.42 15.47	.45 2.68

Economics:

Graph comparing gross margin earn against untreated. Assuming wheat $230p/t, MAP $680 and Liquid P $1.38 p/L. As there was no yield increase with any treatment the additional costs of inputs drove down the margin.



Conclusions Reached &/or Discoveries Made (Not to exceed one page)

Please provide concise statement of any conclusions reached &/or discoveries made.

It is difficult to come to solid conclusions with the season being far from average.

- On clayed sand north of Bordertown the economic yield response from phosphorus applications beyond maintenance with soil test readings between colwell 15 – 20 PBI 20(+-20) is potentially unlikely.
- YEB test results taken at GS22 with %P varying from 0.45 - 0.60 did not affect grain yield in dry year despite visual difference in biomass.
- NDVI correlated mostly with %P suggesting that NDVI correlated with biomass.
- Results do not support claims that increased phosphorus fertiliser improve wheat crops ability to handle drought and frost
- Applying copper via liquid injection has equal benefit as applying foliar, demonstrating that liquid injection copper is viable.

Intellectual Property

Nil

Application / Communication of Results

Field days held at trial site

- Soil pit day hosted in July with a two meter soil pit dug into the wheat crop adjacent to the trial site, examined the depth of roots through the soil profile while assessing soil tests taken down to 40cm. Nine farmers attended along with staff from Spraygro, SARDI and Michael Eyres from Injecta.
- AgBureau annual crop walk October attended by 14 local farmers who help put together the trial protocol.

Future events:
Discussion night at AgBureau on data results

Potential impacts:

- Having data demonstrating that copper liquid injected works as effective as foliar sprays has given confidence to do further work on farm to fine tune the application.
- The impact of the phosphorus data is difficult to predict with the extreme season providing only statistical significant results demonstrating that applications of liquid P does not reduce yield or cause crop damage. Growers will most likely adopt these treatments to paddock scale trials using yield map data as evidence.
- The project has given growers more understanding and confidence on soil and tissue testing and has increased adoption of these tools.

I would suggest the path to market is continue speaking at grower meetings and conferences on results with follow up farm visits with the growers that are considering on adopting the technology.

POSSIBLE FUTURE WORK

Provide possible future directions for the research arising from the project including potential for further work and partnerships.

Potentially it could be considered running the phosphorus treatments again in hope for an average season, however the data is sufficient to convince growers in groups to self-fund and assess half paddock scale trials. Changing from wheat to barley or pulses should be considered if repeated again as it has been shown at other sites that wheat is the least yield responsive crop to increased P inputs, lowering the rate of granular P would also be appropriate.

The three copper treatments could be expanded to capture more data with another season or with another crop species, lower and higher rates, measuring any increased result when higher rates of N are applied, however the copper levels are only just below the adequate range.

Two other trial sites were co-located with this site, boron applications to canola which showed little significant yield advantage and a faba bean fertiliser response site which showed significant increases to phosphorus and calcium applications which the data suggests the maximum yield response was not reached, further work could be expanded to capture this range of response.

AUTHORISATION
Name: Adam Hancock
Position: Agronomist
Signature:
Date:

Submit report via email to admin@sagit.com.au as a Microsoft Word document in the format shown ***within 2 months*** after the completion of the Project Term.