Office Use Only

Project Code	NSS114
Project Type	Research

FINAL REPORT 2017

Applicants must read the *SAGIT Project Funding Guidelines 2017* 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 : **NSS114**

PROJECT TITLE (10 words maximum)
Sulphur deficiency research in lentils & wheat: dune swale soils

PROJECT DURATION

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

Project Start date	**1st April 2014**					
Project End date	31st March 2017					
SAGIT Funding Request	2014/15	$	2015/16	$	2016/17	$

PROJECT SUPERVISOR CONTACT DETAILS

The project supervisor is the person responsible for the overall project

Title:	**First Name:**	**Surname:**
Mr	Leighton	Wilksch
Organisation:		
NSS		
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	Leighton	Wilksch
Organisation:		
NSS		
Mailing address:		

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

PROJECT REPORT

Provide clear description of the following:

Executive Summary (200 words maximum)

A few paragraphs covering what was discovered, written in a manner that is easily understood and relevant to SA growers. A number of key dot points should be included which can be used in SAGIT communication programs

Over the course of the trial, there showed to be minimal variation in crop performance across rates & types of sulphur applied. The site selected had low sulphur levels in accordance with commonly accepted soil parameters (see below table of test results in early 2015). The trial site was in a paddock that was typically of the dune/swale environment of the Northern Yorke Peninsula which allowed for trials to placed on top of the sand dune as well as in the adjacent clay loam swale.

The season of 2015 provided low spring time rainfall and yields of the lentils were ~1T/ha in the clay loam and ~0.8T/ha in the sand dune and there was a high level of variation amongst the plots. The season of 2016 had well above average wheat yields with ~5.4T/ha in the clay loam & ~3.2T/ha in the sand dune.

- Significant yield responses were observed in 2016 wheat.
- Surprisingly, signs of sulphur deficiency during the growing season were not observed, either visually or with GreenSeeker NDVI
- Trends indicated that applying SoA each year, tends to be more effective than applying a larger hit once every 3 years (primarily due to leaching effects of wet winters)
- Soil tests taken in March 2017 (at the conclusion of the project), showed residual sulphur effects of both gypsum and SoA.

Project Objectives

A concise statement of the aims of the project in outcome terms should be provided.

- Responses were observed with the application of sulphur
- Trial has shown trends of type of sulphur source (SoA, gypsum) & rate in regards to effectiveness of yield response
- NSS members observed plots throughout the growing season
- Results were communicated are required

Overall Performance

A concise statement indicating the extent to which the Project objectives were achieved, a list of personnel who participated in the Research Project including co-operators, and any difficulties encountered and the reasons for these difficulties.

The initial scope of the project called for a 3 year rotation to observe the residual effects of sulphur treatments. Unfortunately the initial site in 2014, suffered from a number of factors which included:

- Pre-plant herbicide effect on lentils (plots were re-planted in first week of June 2014)
- A significant freshwater soak that opened up in the clay loam swale and inundated the plots for 4 weeks causing them to die.
- Dry spring finish that saw plots on the sand hill have very low pod numbers and high variation.

Thus the trial site was moved in 2015 and a new site undertaken. So in effect, there have only been 2 years of data collected for this trial project which limits observations of results, particularly as sulphur responsiveness in dryland broad acre crops can depend on how much residual sulphur is left from previous years applications.

So in effect, the outcomes of this project were limited to two seasons. However, these two season were able to demonstrate that there is residual benefits of higher rates of SoA application (although this may not be economic in some seasons with higher SoA prices) as well as the residual benefit of gypsum (which also is likely to be providing some amelioration benefit too)

Leighton Wilksch (NSS Executive offices and Agbyte director) was the trial coordinator & contractor for the entire project.

Low yielding lentils in 2015, were also somewhat of a limitation to the project causing yield variation between plots.

Key Performance Indicators (KPI)

*Please indicate whether KPI's were achieved. The KPI's **must** be the same as those stated in the Application for Funding and a brief explanation provided as to how they were achieved or why they were not achieved.*

KPI	***Achieved (Y/N)***	***If not achieved, please state reason.***
Sites selected & planted	Y	
Plots assessed & harvested	Y	

Data report written & disseminated	Y	

Technical Information (Not to exceed **three** pages)
Provide sufficient data and short clear statements of outcomes.

SOIL TEST RESULTS

March 2015 Soil Test		SAND DUNE			CLAY LOAM SWALE		
Analyte	Unit	0-10 cm	10-30 cm	30-60 cm	0-10 cm	10-30 cm	30-60 cm
pH Water		7.84	8.39	8.82	8.61	8.79	9.43
pH CaCl		7.16	7.38	7.7	7.69	7.83	8.27
EC 1:5	dS/m	0.1	0.09	0.07	0.1	0.12	0.18
Organic Carbon	%	0.4			1.22		
PBI Index		21			80		
Colwell P	mg/kg	32			16		
Colwell K	mg/kg	129			382		
Sulfur (KCl)	mg/kg	1.9	1.8	2.6	2.2	4.7	3.7
NO3 Nitrate	mg/kg	3	1	1.4	1.9	5.8	2.9
NH4 Ammonium	mg/kg	3.1	2.8	1.6	2.1	2.1	1.6

Table 1: showing initial low levels of sulphur, sand dune being lower than the clay loam swale

March 2017 soil test

T1 Untreated		SAND DUNE		CLAY LOAM SWALE	
Analyte	Unit	0-10 cm	10-60 cm	0-10 cm	10-60 cm
Sulphur (KCl)	mg/kg	5.3	4.2	7.1	14.1
NO3 Nitrate	mg/kg	10.6	1.7	8.7	4.4
NH4 Ammonium	mg/kg	3.5	<1	3.0	1.1
T4 Gypsum 1T/ha					
Sulphur (KCl)	mg/kg	26.9	5.1	11.3	20.6
NO3 Nitrate	mg/kg	14.0	2.0	17.4	6.2
NH4 Ammonium	mg/kg	2.2	<1	1.1	1.4
T6 SoA 150kg/ha					
Sulphur (KCl)	mg/kg	10.3	4.3	29.9	27.1
NO3 Nitrate	mg/kg	10.3	1.9	13.7	5.4
NH4 Ammonium	mg/kg	2.6	<1	1.5	1.1

Table 2: shows the residual effects of selected treatments. Gypsum has more residual sulphur in the sand dune, whilst SoA has more residual effect in the clay loam swale.

IN-SEASON LEAF RESULTS

T1 Untreated		SAND DUNE	CLAY LOAM SWALE
Analyte	**Unit**	**0-10 cm**	**0-10 cm**
Sulphur	%	0.34	0.42
Nitrogen	%	6.07	5.91
NDVI (8th Aug)		0.738	0.741
T4 Gypsum 1T/ha			
Sulphur	%	0.42	0.43
Nitrogen	%	5.29	5.91
NDVI (8th Aug)		0.767	0.726
T6 SoA 150kg/ha			
Sulphur	%	0.37	0.42
Nitrogen	%	5.50	6.19
NDVI (8th Aug)		0.743	0.771

Table 3: shows leaf tissue results taken 5th August & NDVI GreenSeeker assessments taken 8th August. No apparent significant differences between the selected treatments of the in-season assessments

YIELD RESULTS

CLAY LOAM					Yield T/ha	Yield T/ha	Yield T/ha
Trt No	**Product**	**Rate kg/ha**	**2015**	**2016**	**2015**	**2016**	**Ave**
3	gypsum	3000	√		1.15	5.63	3.39
6	SoA	150	√	√	1.04	5.60	3.32
8	SoA	100	√	√	1.05	5.51	3.28
10	SoA	75	√	√	1.06	5.48	3.27
7	SoA	150	√		1.03	5.51	3.27
4	gypsum	1000	√	√	1.05	5.49	3.27
5	SoA	300	√		1.05	5.45	3.25
12	SoA	50	√	√	1.02	5.42	3.22
2	gypsum	1000	√		1.03	5.40	3.22
9	SoA	150	√		1.08	5.28	3.18
11	SoA	75	√		1.02	5.28	3.15
1	nil				0.98	4.74	2.86
				CV	**9.8%**	**6.8%**	**8.3%**

				LSD 5%	**0.11**	**0.39**	**0.25**

SAND DUNE					**Yield T/ha**	**Yield T/ha**	**Yield T/ha**
Trt No	**Product**	**Rate kg/ha**	**2015**	**2016**	**2015**	**2016**	**Ave**
6	SoA	150	√	√	0.89	3.60	2.24
10	SoA	75	√	√	0.86	3.41	2.14
12	SoA	50	√	√	0.83	3.34	2.09
8	SoA	100	√	√	0.91	3.17	2.04
7	SoA	150	√		0.87	3.18	2.03
9	SoA	150	√		0.94	3.10	2.02
5	SoA	300	√		0.90	3.14	2.02
2	gypsum	1000	√		0.88	3.06	1.97
3	gypsum	3000	√		0.85	3.07	1.96
11	SoA	75	√		0.93	2.93	1.93
4	gypsum	1000	√	√	0.83	3.00	1.91
1	nil				0.86	2.75	1.80
				CV	**12.6%**	**6%**	**9.3%**
				LSD 5%	**0.19**	**0.32**	**0.26**

Table 3 & 4: show the yield results for season 2015 (lentils) and season 2016 (wheat). Ticks for each year indicate that they have had that treatment applied in that respective year.

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

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

- Leaching potential was high due to periods of saturation during winter & heavy rainfall in 2016 late September; local soil moisture probes indicated this.
- NDVI treatments taken during growing season indicated no significant differences between treatments.
- Tissue tests taken at Z32 on the nil, gypsum @ 1T.\/ha and SoA @ 150kg/ha did not show any significant differences.
- All treatments significantly yielded above the nil untreated on the clay loam,
- There were no significant differences between any of the gypsum or SoA treatments on the clay loam, however, the trend indicated that it was those treatments that had SoA applied in 2015 as well as 2016 were in the top half of the yield table.
- The highest yielding treatment was 3T/ha of gypsum applied in 2015 indicating the benefits of gypsum are long-lasting, both as a source of S and soil amelioration.
- In general, the SoA treatments all yielded significantly above the untreated on the sand dune; however the gypsum treatments did not yield significantly above the untreated.
- 4 out of the 5 highest yielding treatments on the sand dune had SoA applied in 2016 indicating residual S from the 2015 treatments was minimal & likely leached out of the root zone (keep in mind that the 2015 lentils yielded very poorly)

Intellectual Property

Please provide concise statement of any intellectual property generated and potential for commercialisation.

NONE

Application / Communication of Results

A concise statement describing activities undertaken to communicate the results of the project to the grains industry. This should include:

- *Main findings of the project in a dot point form suitable for use in communications to farmers;*
- *A statement of potential industry impact*
- *Publications and extension articles delivered as part of the project; and,*
- *Suggested path to market for the results including barriers to adoption.*

Note that SAGIT may directly extend information from Final reports to growers. If applicable, attach a list of published material.

- SoA is the most effective product for overcoming sulphur deficiency where soil tests show low levels of sulphur (or the previous year's crop showed signs of deficiency)
- Gypsum can also provide adequate levels of sulphur depending on rate applied. Gypsum also has soil amelioration benefits that may see this as the preferred product to apply to manage sulphur requirements of the crop.
- Cost effectiveness between products will vary depending on price fluctuations of SoA as well as location of farm to gypsum source (and whether or not contractors are required to apply products)
- Location logged soil testing on a regular basis is a great way to track the trends of sulphur (and other nutrients) in the soil which will help formulate a plan for maintaining soil levels.
- This trial showed that yield responses to sulphur application can be gained, even when there is no visual signs of deficiency during the growing season.
- By the time that sulphur deficiencies are visible in crop, it is likely that there has been impact on potential crop yield.

This trial again highlights the value of soil testing on a regular basis as well as applying nutrients at rates that will maintain soil nutrient levels rather than allowing for them to decrease. This message is relevant across the entire gains industry.

The trial results have been published in NSS report books that have been circulated to NSS stakeholders as well as other Farming Systems Groups.

There are unlikely to be any significant barriers to adoption for applying findings of this research. Possible exception is growers being apprehensive about doing sol tests

POSSIBLE FUTURE WORK

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

Sulphur management in regards to interactions with other soil amelioration techniques as per Sam Trengove's work is particularly relevant for the NSS region

AUTHORISATION
Name: Leighton Wilksch
Position: Executive Officer & lead researcher Northern Sustainable Soils
Signature:
Date: 26/6/2017

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.