Office Use Only	
Project Code	
Project Type	

FINAL REPORT 2024

Final reports must be submitted using the online application form at www.sagit.com.au with this Word document attached ***within two months*** after the completion of the Project Term.

PROJECT CODE	ARC 3923
PROJECT TITLE	
Are crop yields limited by iron deficiency on calcareous soils of the Yorke Peninsula?	

PROJECT DURATION *These dates **must** be the same as those stated in the Funding Agreement.*						
Project start date	**1/07/2023**					
Project end date	**30/06/2024**					
SAGIT Funding	2023		(year)	$	(year)	$

PRINCIPAL INVESTIGATOR *(responsible for the overall project and reporting)*			
Title:	**First Name:**		**Surname:**
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Mailing address:			
Telephone:		**Email:**	
Mobile:			

ADMINISTRATION CONTACT DETAILS *(responsible for all administrative matters relating to project)*			
Title:	**First Name:**		**Surname:**
	Stefan		Schmitt
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PROJECT REPORT: *Please provide a clear description for each of the following:*

Executive Summary (200 words maximum)
• This project could not obtain the same exciting crop responses to applied Fe that has occurred in highly calcareous soils of the SE. • At two Fe deficient sites on Yorke Peninsula, as interpreted by current soil test interpretation guidelines, there was no crop (wheat or lentil) grain yield response to Fe applied through soil or foliar application during the 2023 growing season. • The 2023 seasonal finish was not kind, despite this, there was no in-season assessment marker that suggested any of the Fe applications methods increased crop performance. • Current soil test guidelines suggest that Fe levels below 10 mg/kg will impede the performance of cereal crops, based on this work this critical level may need adjusting. It should be noted that soil testing for Fe is difficult as availability of Fe is highly variable throughout the season and dependent on climatic conditions. • It appears difficult to boost crop Fe levels and uptake through either soil or foliar applications. It is possible that this was the mechanism behind nonsignificant crop responses. • As a summary, in a season like 2023, crops grown on NYP in calcareous soil types are not deficient in Fe and grain yield increases from applications of Fe are unlikely.

Project objectives
This scoping project will explore if yield limitations caused by Iron (Fe) deficiency are occurring on these soil types where deficiency symptoms in wheat and lentils occur in season. The project aims will be delivered by: 1) Two replicated trials, one in wheat and one in lentils, will assess the impact of different Fe rates, application options (banded and foliar) and different Fe fertilizer products. 2) Two demonstration grower trials to assess yield responses to applied Fe with current grower technology.

Overall Performance
This scoping project achieved the objectives of testing crop responses to application of Fe through various management techniques using two different forms of Fe at two different sites. Importantly these sites were low in available Fe driven through alkaline, calcareous soils using current interpretation guidelines. Both field trials were sufficiently replicated and contained 14 treatments with a large range of rates and application strategies. Two demonstration sites were implemented at Warooka SA which included a paddock scale liquid treatments trial and a paddock scale foliar iron treatment trial. To implement the paddock scale liquid treatment trial a small portable liquid system was used to apply three different Fe treatments across six seeding tynes in paddock length strips. The foliar Fe trial was simply applied with a flag leaf fungicide application on wheat. Trial assessments, data interpretation, statistical analysis and reporting was supported by Sean Mason from Agronomy Solutions.

KEY PERFORMANCE INDICATORS (KPI)		
KPI	**Achieved**	**If not achieved, please state reason.**
Establish two replicated trial sites on NYP	Yes ☒ No ☐	

Coordinate two demonstration grower trials. Includes one grower trial visit during either NSS winter or spring walks.	Yes ☒ No ☐	
Conduct assessments, harvest, and collate all 2023 assessment results	Yes ☒ No ☐	
Submit trial report to NSS (and other farming system group compendiums) annual results booklet	Yes ☐ No ☒	The results from this trial work will be reported in the 2024 NSS trial booklet. Unfortunately, we couldn't fit it in this year's booklet.
Complete and submit progress report to SAGIT.	Yes ☒ No ☐	
Final report submitted to SAGIT	Yes ☒ No ☐	

TECHNICAL INFORMATION (Not to exceed **three** pages)

KPI 1: Two replicated field trials were established on NYP, one near Kulpara which was sown to wheat and one near Thomas Plains which was sown to lentil. The trial design (see supplement report, also submitted with progress report) was as outlined in the proposal and included 14 treatments assessing crop response to applied Fe at sowing at six different rates (as EDDHA), plus either one or two foliar timings (as EDDHA). Fe as EDTA was also included with three additional rates applied at sowing and 2 foliar applications in line with EDDHA timings.

KPI 2: Two demonstration trials were set up with a grower on the SYP near Warooka on highly calcareous soil types. Demonstration (1) comprised strip applications of EDDHA Fe (1 and 2 kg Fe/ha), Amino Boss Fe (5L/ha) and Humisol ZMC (5L/ha) applied at seeding across six seeding tynes on a 54 tyne air seeder. Strips were scored for biomass production during the season and harvested using a commercial harvester, no treatment differences were recorded. Unfortunately, the strips were not individually cut out and harvested due to logistic issues, due to the size of each strip, this may have masked any grain yield responses. However, it was noted during the season that there was no visible difference between the treated strips and adjacent untreated crop at any point in the season, hence a grain yield response was unlikely. The second demonstration trial involved treating a portion of a wheat crop with a foliar application of iron close to flowering. A 20ha area of an 80ha paddock was sprayed with EDDHA Fe at 2kg/ha at the flag leaf stage with a fungicide. The paddock was harvested and the yield map analysed post-harvest, there was no yield improvement realised between the treated and untreated areas of the paddock.

KPI3: Soil test results (for all other characterizations please refer to supplement – Table S2). Each replicate bay was sampled (0-10cm) at both sites to provide an indication of site variation in surface Fe availability.

As current interpretation for Fe sits the soil Fe levels as measured by DTPA extraction were low and at deficiency levels (figure 1). Both sites were characterized by alkalinity, high PBI, low P and presence of calcium carbonate which should act to tie up Fe applications.

	Analyte	Unit	Desired Level	Level Found	c.mol/kg	Very Low	Low	Acceptable	High	Excessive
Trace Elements	Iron (Fe)	mg/kg	10-70	4.1						
	Manganese (Mn)	mg/kg	1.0-10	3.2						
	Copper (Cu)	mg/kg	0.30-1.0	0.56						
	Zinc (Zn)	mg/kg		2.0						

	Analyte	Unit	Desired Level	Level Found	c.mol/kg	Very Low	Low	Acceptable	High	Excessive
Trace Elements	Iron (Fe)	mg/kg	10-70	4.8						
	Manganese (Mn)	mg/kg	1.0-10	4.4						
	Copper (Cu)	mg/kg	0.30-1.0	0.88						
	Zinc (Zn)	mg/kg	0.30-1.5	1.3						

Figure 1: Soil Fe levels (0-10cm) as measured by DTPA method for one of the replicate bays for Thomas Plains (lentils – top) and Kulpara (wheat – bottom) using current interpretation guidelines.

See supplement report for in season (NDVI, plant tissue) analysis. In brief, there was no significant (p > 0.05) response to Fe products applied at sowing, or two additional in season foliar applications at both sites. NDVI assessment occurred at three-time intervals at Thomas Plains (Lentil) and two times at Kulpara (Wheat) in line with pre and post Fe foliar applications. Approximately two weeks after the final in season foliar treatment, plant YEBs or top nodes were taken and measured for plant Fe concentrations. At both sites we could not significantly increase the plant Fe concentration or overall uptake using NDVI as a surrogate for yield. This means we could not get extra Fe into either crop through the soil or via the plant.

Grain yields

Thomas Plains – Lentils

At maturity, no significant (p > 0.05) response to applied Fe through soil, foliar or form was obtained (p = 0.92). Lentil yields were low and ranged from 0.97 to 1.09 t/ha with the control at 1.06 t/ha (figure 2). There was no relationship of lentil grain yields with increasing applied Fe. There was no increase in grain Fe concentrations and therefore subsequent uptake from any of the treatments (p = 0.51, table S3)

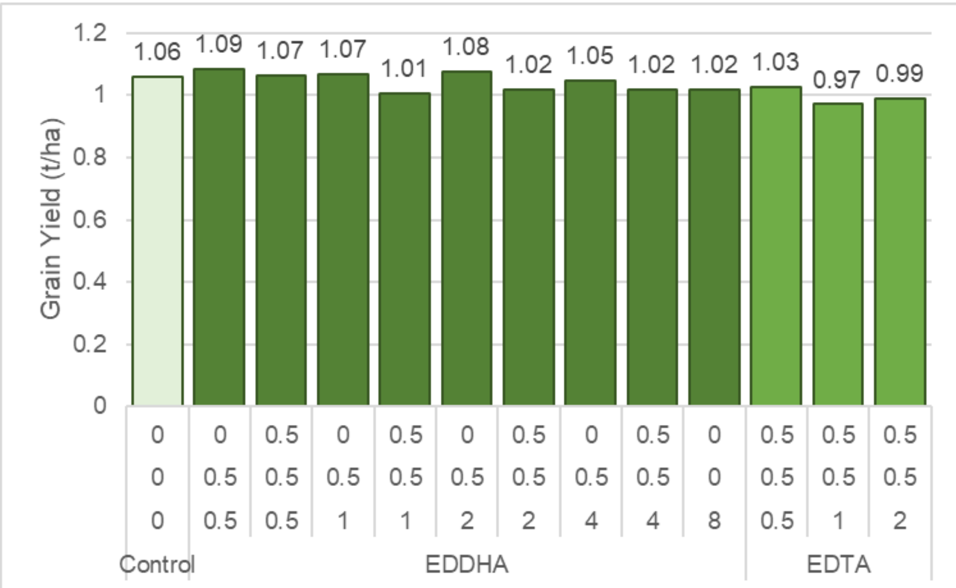

Figure 2: Mean (4 reps) lentil grain yields for each treatment combination and Fe product. The bottom line represents applied Fe at sowing (kg/ha), the second line is Fe applications (kg/ha) at first foliar and top line is Fe applications (kg/ha) at second foliar which coincided with flowering.

Kulpara – Wheat

Applications of two forms of Fe either through the soil or foliar did not significantly (p = 0.528) increase wheat grain yields or significantly increase grain Fe uptake (p = 0.812). Yields ranged from 1.89 t/ha on the control to 2.14 t/ha for EDDHA applied at 4 kg/ha and one foliar treatment. There was one trendline obtainable with increasing EDDHA application rate at sowing and grain yield in addition to one foliar but all other treatment placement with respect to this observation suggests this is not a real response to Fe and driven by the yield obtained at 4 kg Fe/ha (Figure 4).

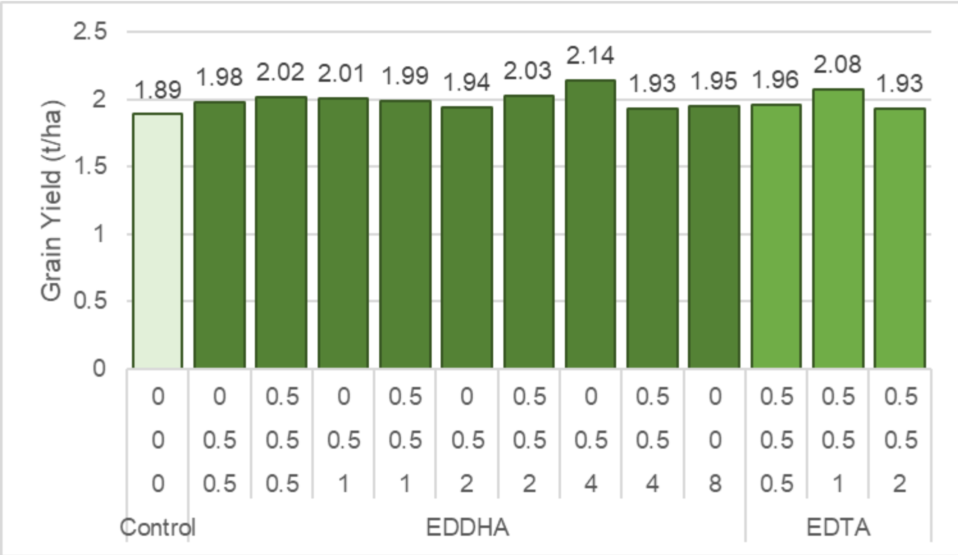

Figure 3: Mean (4) wheat grain yields for each treatment combination and Fe product. The bottom line represents applied Fe at sowing (kg/ha), the second line is Fe applications (kg/ha) at first foliar and top line is Fe applications (kg/ha) at second foliar which coincided with flowering.

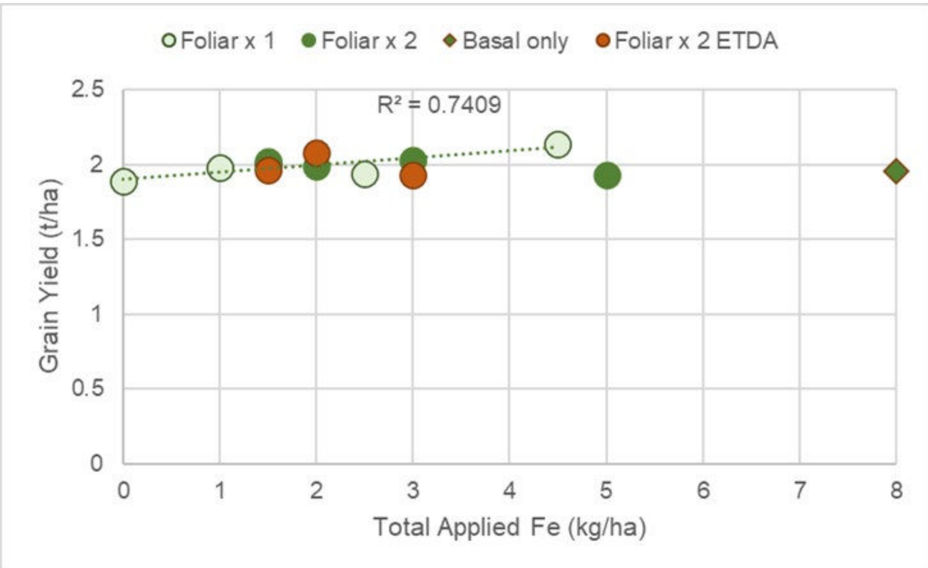

Figure 4: Grain yield relationships with applied Fe (left) and overall grain Fe uptake with Fe treatment (right) at Kulpara - Wheat.

CONCLUSIONS REACHED &/OR DISCOVERIES MADE (Not to exceed **one** page)

- At two Fe deficient sites, identified using current soil test interpretation guidelines and in the presence of high levels of calcium carbonate there was no crop (wheat or lentil) grain yield response to applied Fe either through soil application or foliar whether that was one or two timings.
- Seasonal finish was not kind but there was no in season assessment marker that suggested the applied Fe through various methods increased crop performance.
- Current soil test guidelines suggest below 10 mg/kg is critical, but this might need adjusting. It should be noted that soil testing for Fe is difficult as availability of Fe is highly variable throughout the season and dependent on climatic conditions.
- In a season like 2023, crops grown on NYP in calcareous soil types are not deficient in Fe and grain yield increases from in crop applications of Fe are unlikely.

INTELLECTUAL PROPERTY

None generated

APPLICATION / COMMUNICATION OF RESULTS

- Initial results presented at Crop Science Society meeting – 20th September 2023
- Results presented as part of an Elders micronutrient management workshop – Mannum 28th February 2024
- Thomas Plains trial site visited by local independent consultant along with thirteen local farming clients during July of 2023.

POSSIBLE FUTURE WORK

The initial project proposal had scope for two seasons worth of trials but considering these results, project participants decided not to pursue the second year through another application to SAGIT.