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Project Code	
Project Type	

FINAL REPORT 2024

PROJECT CODE	AEP-01422-R
PROJECT TITLE	
Eyre Peninsula internship in applied grains research 2023	

PROJECT DURATION						
Project start date	**1/07/2022**					
Project end date	**30/06/2024**					
SAGIT Funding	22-23		23-24		(year)	$-

PRINCIPAL INVESTIGATOR		
Title:	**First Name:**	**Surname:**
Ms.	Amanda	Cook
Organisation:	SARDI	
Mailing address:		
Telephone:		**Email:**
Mobile:		
Other Research Staff	Sara Blake, Research Scientist & Pulse Pathology Sub Program Leader, SARDI (supervisor and mentor role with Amanda Cook).	

ADMINISTRATION CONTACT DETAILS		
Title:	**First Name:**	**Surname:**
Ms.	Naomi	Scholz
Organisation:	Agricultural Innovation & Research Eyre Peninsula	
Mailing address:		
Telephone:		**Email:**
Mobile:		

PROJECT REPORT:

Executive Summary

- Zhaohan (Elijah) Luo was appointed to the Eyre Peninsula internship in applied grains research based at the SARDI Minnipa Agricultural Centre in 2023. The internship has been very successful with Elijah gaining experience and knowledge of Australian low rainfall farming systems, practical research skills including herbicide and fungicide use, trial design and implementation, trial analysis, writing, mentoring by local growers, training and confidence in extension presenting his research topic to growers and industry representatives at numerous events. Elijah has continued employment at SARDI Minnipa Agricultural Centre to increase the research capacity on upper Eyre Peninsula.
- Elijah Luo's research project was selected as 'Management of foliar disease in lentils on the Upper Eyre Peninsula' due to the rapidly increasing area of lentils being grown in the region.
- This research project consisted of five field trials located at three trial sites at Mount Cooper (2), Mount Damper (2) and Minnipa Agricultural Centre (MAC) (1). Both Mount Cooper and Mount Damper sites had a fungicide and a variety trial, whereas MAC only had a variety trial. The assessments conducted at each site during growing season were plant emergence, early and late normalized difference vegetation index (NDVI), late dry matter, percentage plot disease, and weather data collection. The grain was harvested and weighed using the Zurn small plot harvester. Grain quality assessments of the lentil grain harvested from two sites were compared post-harvest.
- In 2023, the growing season conditions on the upper Eyre Peninsula were not conducive for lentil foliar fungal diseases Ascochyta blight (AB) or Botrytis grey mould (BGM).
- Fungicide sprays in a Decile 1-2 rainfall season when there was low disease pressure were not needed to maximise gross margin in lentils on upper Eyre Peninsula (UEP) in this one-year study.
- No lentil varieties consistently out-performed others in terms of yield or quality in this one year at all sites.
- The low levels of foliar disease in lentils in 2023 did not influence grain quality grades.

Project objectives

The objectives of this internship were:

1. To improve the capacity of grains research, development and extension in the Eyre Peninsula region.
2. To further develop applied research skills of recent graduates so they will be able to make an improved contribution to the grains R,D&E industry in South Australia.

Lentil cropping areas are rapidly expanding on the Upper Eyre Peninsula (UEP). After a high rainfall year like 2022, it was identified that more information was needed to determine if one fungicide spray is sufficient to provide effective disease control or whether multiple fungicide sprays provided any additional benefit in lentils. This project aimed to:

1. Investigate if only one fungicide spray is sufficient for controlling AB and BGM in a low rainfall region in a moderately disease resistant lentil variety (GIA Thunder IMI).
2. Determine the effectiveness of various fungicide strategies in only one spray application.
3. Determine which fungicide strategies result in the highest gross margin by the end of the season.
4. Determine which lentil variety can produce the highest yield in a low rainfall region.

Overall Performance

Zhaohan (Elijah) Luo was appointed to the Eyre Peninsula internship in applied grains research based at the SARDI Minnipa Agricultural Centre in 2023-2024. The internship role has been very successful with Elijah gaining experience and knowledge of Australian low rainfall farming systems, practical research skills and confidence in extension presenting his research topic to growers and industry during this time.

The objectives of the internship were achieved. Not having an agricultural background and being new to the Minnipa district, it took some time for Elijah to learn and understand that EP farming systems

can have major variations across different locations. Elijah learnt many skills during the internship including trial design and implementation, research delivery processes including machinery operation, application of herbicides and fungicides, trial analysis, writing, mentoring by several local growers and MAC Farm staff, training including Off Road Driving, National Leadership mentoring Program by ARLF, Statistical Internship by the Biometry Hub, University of Adelaide and Facilitation of Groups course. Elijah has since continued employment at SARDI Minnipa Agricultural Centre to increase the research capacity on upper Eyre Peninsula.

Above: Bill Long (AIR EP Chair, Elijah Luo 2023 intern and Amanda Cook, SARDI host) at the GRDC updates, February 2023 - Elijah's first week on the job.

Elijah Luo's research project was selected as 'Management of foliar disease in lentils on the Upper Eyre Peninsula' due to the rapidly increasing area of lentils being grown in the region.

The five upper Eyre Peninsula research trials were located at three sites, Mount Cooper (2), Mount Damper (2) and Minnipa Agricultural Centre (MAC) (1). Both Mount Cooper and Mount Damper sites had a fungicide and a variety trial, whereas MAC only had a variety trial. The assessments conducted at each site during growing season were plant emergence, early and late normalized difference vegetation index (NDVI), late dry matter, percent plot disease, and weather data collection. The grain was harvested and weighed using the Zurn small plot harvester. Grain quality assessments of the lentil grain harvested from two sites were compared post-harvest for delivery grade assessment.

The key findings from the 2023 lentil fungicide and variety trials were:

- In 2023, the growing season conditions on the upper Eyre Peninsula were not conducive for lentil foliar fungal diseases Ascochyta blight (AB) or Botrytis grey mould (BGM).
- Fungicide sprays in a Decile 1-2 rainfall season when there was low disease pressure were not needed to maximise gross margin in lentils on upper Eyre Peninsula (UEP) in this one-year study.
- No lentil varieties consistently out-performed others in terms of yield or quality in this one year at all sites.
- The low levels of foliar disease in lentils in 2023 did not influence grain quality grades.

<u>Personnel involved in the SARDI Intern research project:</u>
Minnipa Agricultural Centre: Amanda Cook (Research Leader MAC – Principal Supervisor), Nicole Baty (Project Management Officer), Rhiannon Schilling (Program Leader Agronomy). SARDI Technical staff - Ian Richter, Kym Zeppel, Craig Standley, Marina Mudge, John Kelsh and Wade Sheppard.

Sara Blake (Pulse Pathology – Co supervisor and training in lentil foliar disease ratings), Navneet Aggarwal (SARDI Clare – Lentil Herbicides), Nigel Wilhelm and Luke Simpson (SARDI Waite).

Growers: AJ Michael (Mount Damper) and Angus Gunn (Mount Cooper).

Statistical support: Olena Kravchuk (Biometry Hub, University of Adelaide).

Industry Reps: Jenny Davidson (SAGIT), Naomi Scholz & Amy Wright (AIR EP).

<u>Other Personnel involved in the SAGIT Internship:</u>

Grower mentors: Bruce Heddle (Minnipa), Matthew Cook (Condada) & Wes Daniell (Minnipa).

Researchers, Consultants, and Industry Reps:
Andy Bates & Michael Hind (Bates Agricultural Consulting), Larn McMurray (Grain Innovations Australia), local agronomists involved in Lentil Check Groups - James Cant, Kevin Dart, Leigh Davis, Jake Hull, Bella Heron, Andrew Ware & Brett Masters (EPAG Research), Rachel May (SA Drought Hub) and Jeanette Long (Ag Consulting Co.).

Elijah also spent a week with EPAG Research in Port Lincoln in November 2023.

KEY PERFORMANCE INDICATORS (KPI)		
KPI	**Achieved**	**If not achieved, please state reason.**
Appoint regional intern for 2023	Yes ☒ No ☐	
2023 Regional Intern delivers report on their activities, including key findings for research project.	Yes ☒ No ☐	
Conduct review of Intern position. What worked/ what could be improved. Report delivered to SAGIT as part of annual reporting.	Yes ☒ No ☐	
Final Report delivered to SAGIT – including a review of the success/shortcomings and impact of the project	Yes ☒ No ☐	

TECHNICAL INFORMATION

Research project: Management of foliar disease in lentils on the Upper Eyre Peninsula (Summarised Key findings):

Eyre Peninsula Farming Systems 2023 Summary 'Management of foliar disease in lentils on the Upper Eyre Peninsula' article, will be printed and distributed to EP growers and industry representatives in April 2024.

Fungicide trials

In this low disease and low rainfall year, there were no significant differences between fungicide treatments at either Mt Damper or Mt Cooper for disease level, NDVI, grain yield or grain quality.

Disease levels, rated as percentage of the plot with AB symptoms, were very low (<8%) throughout the growing season at both trial sites (Figure 1). AB is a seed and stubble borne disease that is promoted by rain-splash in winter, whilst BGM is usually associated with mild temperatures (15-25°C) and high relative humidity (>70%) in spring. The low disease scores in both trials reflects the dry conditions in late winter and spring at the sites.

NDVI was used as a non-destructive biomass sampling method to indicate the level of biomass from each treatment. However, there was no significant difference in late NDVI values (27 September) between treatments at both sites.

Mount Damper had a higher average yield (1.59 t/ha) than Mount Cooper (1.22 t/ha) but there was no significant difference between each treatment. Due to low disease levels, only 300 grain weights were measured for quality assessment but no significant difference between treatments were observed. Lentils at Mount Damper had higher 300 grain weights on average than Mount Cooper, even though Mount Cooper had higher late NDVI values on average than Mount Damper.

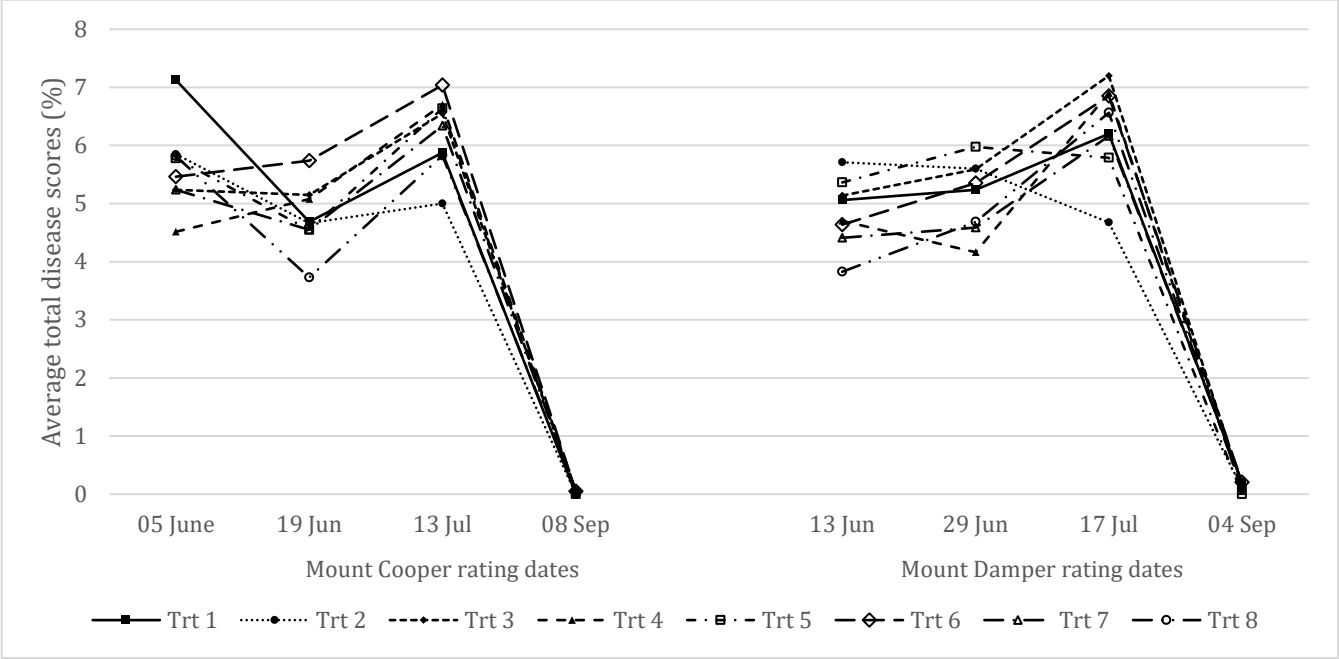

Figure 1: Average total disease scores in 2023 of the eight fungicide treatments on GIA Thunder IMI lentils rated on four occasions at Mount Cooper (05 June, 19 June, 13 July and 08 September) and Mount Damper (13 June, 29 June, 17 July and 04 September).

Variety trials:

AB disease levels in the variety trial at both sites were also very low (Figure 2 and 3) and there was no significant difference between the Full Disease (no fungicides applied) and No Disease (fungicides applied) treatments. PBA Hallmark XT, rated MRMS to AB pathotype 2, had the highest disease scores throughout the season overall, while PBA Jumbo2, rated RMR(p) to AB pathotype 2, had the lowest disease scores, but the difference between each variety was not significant.

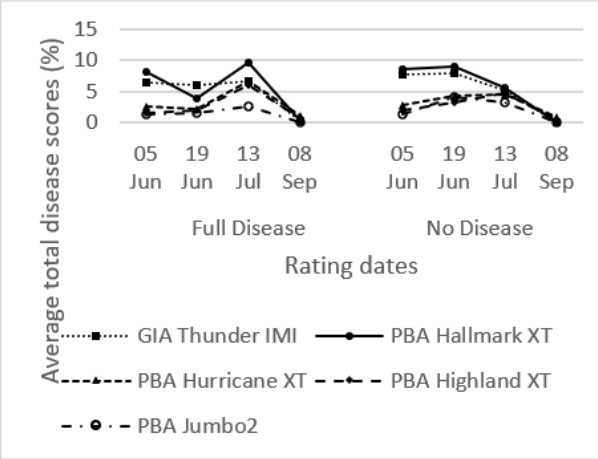

Figure 2: Average total disease scores of each of the five lentil varieties in the both the Full Disease and No Disease whole-plot treatments combined as rated on four occasions at Mount Cooper in 2023

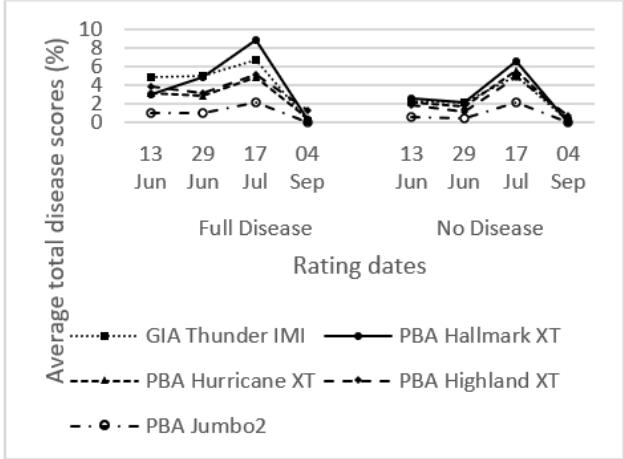

Figure 3: Average total disease scores of each of the five lentil varieties in the Full Disease and No Disease whole-plot treatments combined as rated on four occasions at Mount Damper in 2023

A positive linear correlation was observed between biomass and estimated yield at Minnipa and Mount Damper (Figure 4). The Minnipa site showed a stronger biomass-yield correlation than Mount Damper. The Mount Cooper site showed no correlation.

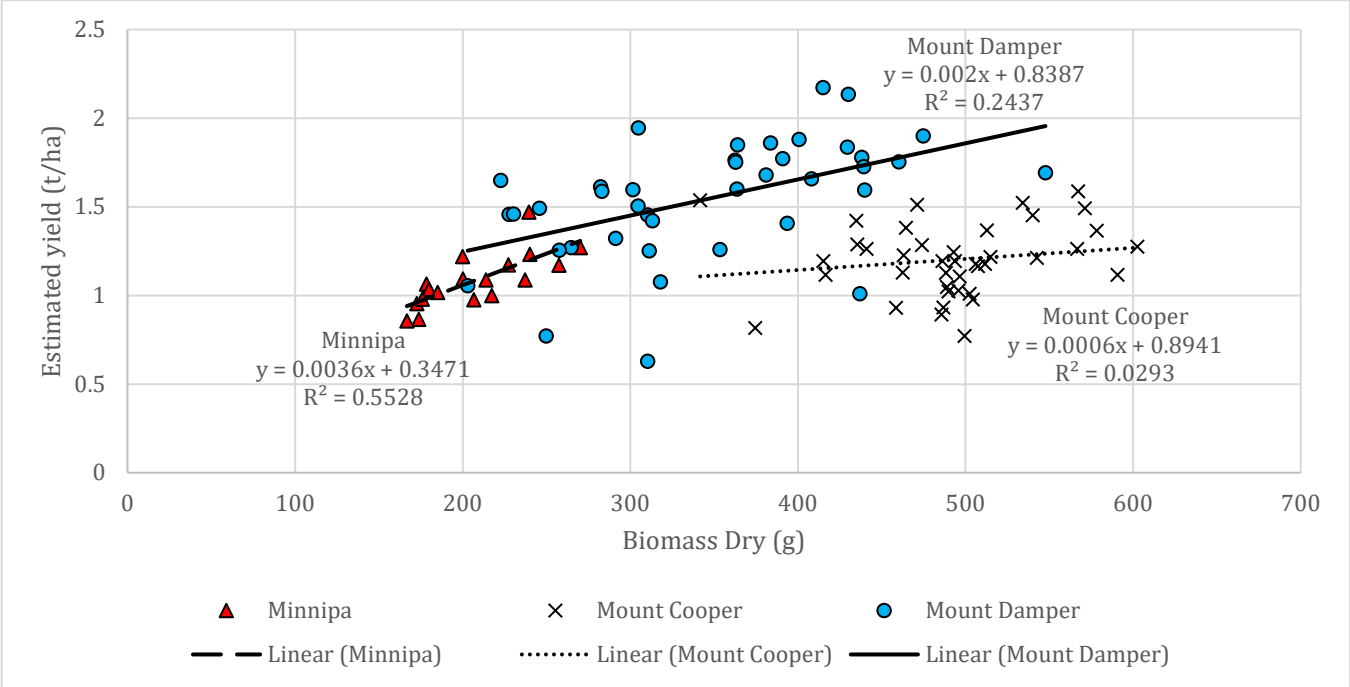

Figure 4: The relationship between biomass and estimated lentil yield at Minnipa, Mount Cooper, and Mount Damper lentil variety trials in 2023.

Trials were harvested and estimated yield calculated (Table 1). At Minnipa, GIA Thunder IMI was the highest yielding variety, and this was significantly higher than PBA Hallmark XT. At Mount Cooper, there was a significant effect of variety in the Full Disease (no fungicides applied) treatment only where PBA Highland XT recorded the highest yield, but this was statistically similar to yields for PBA Hurricane XT, GIA Thunder IMI and Jumbo2.

At Mount Damper, lentil harvestability issues were encountered during harvesting which were scored and accounted for in the statistical analysis. The harvestability issues did not appear to influence the general trend in yields after yield adjustments. No multiple comparisons were done on Mount Damper yields.

Table 1: The estimated lentil yields (t/ha) harvested from variety trials in Minnipa, Mount Cooper and Mount Damper 2023 (*Mount Damper trial encountered harvest issues. The mean yield data displayed for Mount Damper in this table was the adjusted mean. Therefore, no multiple comparisons were done between varieties either fungicide treatment) (ns* meaning no significant difference between treatments).

Variety	**Minnipa**	**Mount Cooper**		**Mount Damper* (Adjusted for harvest loss)**	
		Full Disease	No Disease	Full disease	No Disease
GIA Thunder IMI	1.25 a	1.18 ab	1.24	1.87	1.15
PBA Hallmark XT	1.05 b	0.96 b	1.13	1.75	1.27
PBA Hurricane XT	1.11 ab	1.22 ab	1.42	1.76	1.59
PBA Highland XT	1.07 ab	1.27 a	1.27	1.84	1.36
PBA Jumbo2	1.04 ab	1.05 ab	1.30	1.63	1.49
GIA Lightning IMI	1.06 ab	N/A		N/A	
F prob (Variety)	<0.05	<0.05	ns	ns	ns
LSD (Variety) (F prob=>0.05)	0.28	0.20	ns	0.2	ns
*F prob (Fungicide*Variety)*	N/A	ns*		ns	

Varietal results for total defective grains varied across each site. At Minnipa, GIA Thunder IMI and GIA Lightning IMI had the least number of total defective grains, though not statistically different from PBA Hallmark XT, PBA Hurricane XT and PBA Highland XT, whereas PBA Jumbo2 had the most total defective

grains (Table 2). At Mount Cooper and Mount Damper, significant differences between varieties were detected only in the Full Disease treatment. At Mount Cooper, PBA Hallmark XT had the least total defective grains and PBA Highland XT had the most total defective grains (Table 2), while in Mt Damper, GIA Thunder had the least total defective grains, and PBA Hurricane XT, PBA Highland XT and PBA Jumbo2 had the most total defective grains. There was no significant interaction between fungicide treatment and variety.

Table 2: The mean weight of total defective grains (g) (defective + poor colour) of lentils harvested from variety trials at Minnipa, Mount Damper and Mount Cooper in 2023.

Variety	Minnipa	Mount Cooper		Mount Damper	
		Full Disease	No Disease	Full Disease	No Disease
GIA Thunder IMI	4.46 b	3.52 ab	3.478	2.26 b	2.09
PBA Hallmark XT	6.11 ab	3.38 b	3.670	2.65 ab	2.54
PBA Hurricane XT	7.35 ab	4.39 ab	4.275	3.25 a	3.34
PBA Highland XT	6.62 ab	4.56 a	4.293	3.07 a	3.13
PBA Jumbo2	7.59 a	3.64 ab	4.290	3.09 a	3.11
GIA Lightning IMI	4.48 b	N/A		N/A	
F prob (Variety)	<0.05	<0.05	ns	<0.05	ns
L.S.D (Variety) (F prob=>0.05)	1.96	0.78	ns	0.45	ns
*F prob (Fungicide*Variety)*	N/A	ns		ns	

CONCLUSIONS REACHED &/OR DISCOVERIES MADE

Fungicide trials:

Fungicide applications for control of lentil foliar disease were unnecessary on the UEP in 2023. The fungal foliar diseases, AB and BGM of lentils, were at very low levels likely due in part to the Decile 1-2 growing season rainfall in that region. These diseases require sufficient moisture either as frequent rainfall or high humidity present in the crop as dew, fog, or high soil moisture. The retail prices and the cost of implementing each treatment suggest that UEP growers who did not put out a fungicide would have saved between $13-56/ha. Thus, in this one-year study, it suggests that on the UEP there was no benefit from applying foliar fungicides in a below average rainfall season and in a below average disease year.

Variety trials:

Aiming to maximise crop biomass to suit rainfall levels to achieve high yield is important. A positive, linear correlation between biomass and final yield was revealed across low (Minnipa) and medium (Mount Damper) rainfall areas on the UEP but not relatively higher rainfall areas (Mount Cooper).

No fungicide application was necessary at Minnipa (Decile 2-3 rainfall), Mount Cooper (Decile 5 rainfall) or Mount Damper (Decile 2-3 rainfall) in the 2023 season with the disease pressure present at these sites, and varietal differences was dependent on the site. Therefore, in a below average rainfall year like 2023, no fungicide application was required on UEP regardless of the lentil variety grown in this one-year study with little disease pressure.

The yield and quality of all varieties varied across different sites. In a season like 2023, poor colour would not play a significant role in lentil grades determination due to a lack of diseases to stain the seeds during podding. Most of the poor colour grains found in this year's trial was most likely due to the heat and drought stress crops experienced during podding.

The average possibility of grades for each variety tested in the trials in 2023 at Minnipa, Mount Cooper and Mount Damper was calculated. At Minnipa, GIA Lightning IMI and GIA Thunder IMI were more likely to receive NIPT1 grade with a probability of 66% and 33% respectively, with relatively low deduction if they had received NIPTB grade. At Mount Cooper, GIA Thunder IMI (87.5%) and PBA Hallmark (75%) were more likely to receive NIPT1 grade. At Mount Damper, PBA Hurricane and PBA Jumbo2 were less likely to receive top grade than other varieties. However, due to the minimal foliar

disease levels observed, it is not possible to make conclusive claims about grain grades, thus more research is required to investigate the profitability of lentil varieties on the UEP.

Intern Extension Activities

• Elijah Luo attended the eight GRDC Lentil Check Grower Group Meetings in March and June 2023 facilitated by Bates Agricultural Consulting and other local agronomists.

• Elijah Luo presented his research project and in-season research results at the SAGIT Annual Update on 5 July 2023.

• Elijah Luo presented his research trials at Mount Cooper, Mount Damper and Minnipa sites to the SAGIT Trustees on the EP trial tour on 31 August 2023.

• Elijah Luo presented research project outcomes to 149 growers and industry reps at SARDI Minnipa Agricultural Centre Field Day on 11 September 2023.

• Elijah Luo presented his research project and in-season results at the SARDI Crop Sciences Forum on 24 October 2023.

• Elijah Luo presented his research trials at the Mount Cooper Sticky Beak Day.

• Elijah Luo attended the AIR EP Low Rainfall RD&E Committee meetings where research projects and results are discussed with local growers and agronomists.

• Elijah presented research project outcomes at SARDI Minnipa Agricultural Centre EP Farmer Harvest Meetings in February/March 2024.

Review of intern program

A review of the intern program was conducted during December 2023, with participating organisations on EP (AIR EP, EPAG Research, SARDI).

<u>SUMMARY OF KEY AREAS of opportunities</u>

Within internship

- Greater interactions with current and past interns across the state
- Review timeframe – is 2 years a good/better target? This has been tried by Hart before, SAGIT only funded 1 round of these.
- Formal training opportunities
- Structured performance review
- Greater interaction with broadacre farmers/processes
- Opportunities for further education (honours) within internship

Attracting candidates to increase RD&E capacity on EP

- Face to face promotion with Waite university students to increase applications (Hart do this with second year students, third year students are too late)
- School student exposure to different opportunities in agriculture

Higher-level discussion about how to maintain capacity in regional areas with all parties invested, as per EP Ag Vision 2050.

The internship program has proven invaluable for attracting skilled graduates to the EP and retaining them in ongoing careers, with three of our past interns finding jobs in agricultural research with AIR EP (Rebekah Fatchen), EPAG Research (Rhaquelle Meiklejohn) and SARDI (Elijah Luo).

INTELLECTUAL PROPERTY
Not applicable

APPLICATION / COMMUNICATION OF RESULTS

Zhaohan (Elijah) Luo was appointed to the Eyre Peninsula internship in applied grains research based at the SARDI Minnipa Agricultural Centre in 2023. The internship has been very successful with Elijah gaining experience and knowledge of Australian low rainfall farming systems, practical research skills, training and confidence in extension presenting his research topic to growers and industry representatives at numerous events. Elijah has continued employment at SARDI Minnipa Agricultural Centre to increase the research capacity on upper Eyre Peninsula.

Elijah Luo's research project was selected as 'Management of foliar disease in lentils on the Upper Eyre Peninsula' due to the rapidly increasing area of lentils being grown in the region.

This research project consisted of five trials located at three trial sites, Mount Cooper (2), Mount Damper (2) and Minnipa Agricultural Centre (MAC) (1). Both Mount Cooper and Mount Damper sites had a fungicide and a variety trial, whereas MAC only had a variety trial.

The key research outcomes were:

- In the 2023 growing season conditions on upper Eyre Peninsula were not conducive for lentil foliar fungal diseases Ascochyta blight (AB) or Botrytis grey mould (BGM).
- Fungicide sprays were not needed in a decile 1-2 rainfall season for maximum gross margin in lentils on upper Eyre Peninsula (UEP) when there was low disease pressure.
- No lentil varieties consistently out-performed others in terms of yield or quality.
- Foliar disease level in lentil did not influence grain grades at delivery in a below average rainfall year (2023).

Extension Activities

Published articles

Eyre Peninsula Farming Systems 2023 Summary 'Management of foliar disease in lentils on the Upper Eyre Peninsula' article, will be printed and distributed to EP growers and industry representatives in April 2024.

Minnipa Agricultural Centre Field Day Booklet, 'Fungicide Management of fungicide disease in selected lentil varieties on the Upper Eyre Peninsula', p. 33.

Verbal Presentations

Elijah Luo presented his research project and in-season research results at the SAGIT Annual Update on 5 July 2023.

Elijah Luo presented research project outcomes to 149 growers and industry reps at SARDI Minnipa Agricultural Centre Field Day on 11 September 2023.

Elijah has presented research project outcomes at SARDI Minnipa Agricultural Centre EP Farmer Harvest Meetings in February/March 2024, plus numerous other speaking opportunities to growers and industry.

General project communications

1. Article in AIR EP e-newsletter published 13 February 2023: https://airep.com.au/news/new-staff-at-sardi-minnipa-ag-centre/
2. Media release: 5 July 2023 "Internship promotes grain research on Eyre Peninsula", published in EP Advocate 20 July 2023.
3. Webpage: https://airep.com.au/research/eyre-peninsula-internship-in-applied-grains-research-2023/
4. Informal SAGIT funded intern networking dinner organised by AIR EP held 5 February 2024, for past and incoming SAGIT funded interns to get a chance to meet each other.

POSSIBLE FUTURE WORK

More work involving fungicides in lentils on the UEP is needed as it is still unclear how various fungicide application strategies influence the final yields, grades and growth margins of different lentil varieties on UEP environment in above-average rainfall seasons.

Many growers have encountered harvestability issues in lentil crops. EP growers have asked if increasing stubble heights would provide protection for the establishing lentil crop, increased dry matter, and improve harvestability of lentils while increasing in-season soil protection. However, there is limited information available on the harvestability of lentils on the upper Eyre Peninsula.

Herbicides in lentils for medic control on grey calcareous soils and improving lentil nodulation on grey calcareous soils of upper Eyre Peninsula are other topics of potential for future work given lentils are expanding into these soil types.

The internship program is highly valuable for the Eyre Peninsula region and continued investment to attract new staff to this regional area is required to help address a shortfall in future scientists for this area and the grains research field in general.