

2023 Trial Reports



UOA2105-013RTX – Development and extension to close the economic yield gap and maximise farming system benefits from grain legume production in South Australia.



UNOFFICIAL

Acknowledgements

The research undertaken as part of the GRDC-funded SA Grain Legume Validation project (UOA2105-013RTX) is made possible by the significant contributions of growers through both trial cooperation and the support of the GRDC, and the authors would like to thank them for their continued support. The continued support from industry and breeding organisations for the provision of chemical products and pulse varieties for use in field trials is also gratefully acknowledged and appreciated.

Project management

Sarah Day, SARDI Agronomy

Project Investment

Grains Research and Development Corporation: Project UOA2105-013RTX Development and extension to close the economic yield gap and maximise farming systems benefits from grain legume production in South Australia

Contributions and Trial Management

Melrose, Coomandook, Riverton/Tarlee, Hart/Condowie: Sarah Day, **SARDI Agronomy Clare** sarah.day@sa.gov.au

Kimba and Tooligie: Amy Keeley, **SARDI Agronomy Port Lincoln** amy.keeley@sa.gov.au

Loxton and Pinnaroo: Michael Moodie, **Frontier Farming Systems** michael@frontierfarming.com.au

Mount Hope and Cummins: Andrew Ware, **EP AG Research** andrew@epagresearch.com.au

Millicent: Aaron Vague, **FAR Australia** aaron.vague@faraustralia.com.au

Maitland, Bute and Kulpara: Sam Trengove, **Trengove Consulting** samtrenny34@hotmail.com

Extension Hosts

Loxton, Pinnaroo and Lameroo: Paige Cross, **Mallee Sustainable Farming** paige@msfp.org.au

Mount Hope, Cummins, Kimba and Tooligie: Naomi Scholz, **AIR EP** eo@airep.com.au

Millicent: Aaron Vague, **FAR Australia** aaron.vague@faraustralia.com.au

Maitland, Bute and Kulpara: Sam Trengove, **Trengove Consulting** samtrenny34@hotmail.com

Melrose: Jade Rose **Upper North Farming Systems** jade@unfs.com.au

Riverton/Tarlee: Jarred Tilley **Mid North High Rainfall Zone** greenwith.invermay@outlook.com

Hart/Condowie: Sandy Kimber, **Hart Field Site Group** admin@hartfieldsite.org.au

Cover image: Sunset over a lentil crop, north of Brinkworth, 2023. Photo credit: Sarah Day



Trengove Consulting



CONTENTS

Mt Hill	4
Edillilie.....	6
Conclusions and implications.....	8

MT HILL

Authors: Andrew Ware, EP AG Research

Background: This site was selected as a sandy soil, neutral to slightly acidic (Table 1), that has traditionally only grown lupins and canola as break crops. Higher value pulse crops, such as lentil and faba beans, have the potential to add diversity to the crop rotation, providing alternative control options for ryegrass and potentially adding profitability across the rotation. However, the value to the system is hard to realise with little previously work testing high value pulses in the region, and thus, information on their impact on the following wheat crop is currently limited.

Rainfall:

Av. Annual: 396 mm	2022 Total: 553 mm	2023 Total: 346 mm
Av. GSR: 315 mm	2022 GSR: 364 mm	2023 GSR: 267 mm

Table 1. Pre-season soil test results, Mt Hill 2022. N/A = sample not tested.

Depth (cm)	pH 1:5 (H ₂ O)	pH CaCl ₂	Organic Carbon (%)	MIR - Aus Soil Texture	Nitrate - N	Ammonium - N	Colwell P (mg/kg)	PBI + Col P
0-10	7.09	6.61	1.06	Sand	7.7	<1	24	17
10-30	8.13	7.28	N/A	Sand	4.3	<1	N/A	N/A
30-60	9.14	8.28	N/A	Sandy clay	3.1	<1	N/A	N/A
60-100	9.62	8.51	N/A	Clay loam	6	<1	N/A	N/A

Aim:

1. To determine the relative yield of a range of break crops (pulses) compared to the traditionally grown canola on a sandy soil, Lower Eyre Peninsula.
2. To determine the impact of the break crops on the following wheat crop.

Methodology and results:

1. 2022 Canola (cv 44Y94CL), Faba Beans (cv PBA Samira), Lentils (cv PBA Hurricane XT), Lupins (cv AGT Coyote), and Vetch (cv Studencia) were planted, using seeding rates and label broadleaf weed control suitable for each crop. Canola received 200kg/ha of urea as per district practice. All pulses and canola received 100kg/ha MAP at seeding.

Table 2. 2022 Break crop grain and biomass yield (t/ha), gross margin (\$/ha) and mineral N (kg/ha), Mt Hill. Data labelled with the same letters within a column are not significantly different (P<0.05). lsd = least significant difference.

Crop type	Grain Yield (t/ha)	Total Biomass (inc. grain) at Maturity (t/ha)	Gross Margin (\$/ha) **	Mineral N March 2023
Canola	2.68 bc	11.38 a	913	55.9
Faba Bean	4.44 a	13.12 b	1,894	44.6
Lentil	2.26 cd	10.09 b	1,000	30.4
Lupin	2.94 b	10.01 b	783	39.6
Vetch	2.11 d	11.21 b	886	45.0
Vetch BM*	0 e	6.59 c	-381	71.1
lsd	0.47	1.47		

*BM = brown manured (sprayed off early October), **using 2024 SA Gross Margin Guide

2. In 2023 wheat (cv Scepter) was sown onto the previous year' plots, with 100kg/ha DAP at sowing and 200kg/ha of urea in June.

Table 3. 2023 wheat grain and biomass yield (t/ha), grain protein (%) and cumulative (2-year) gross margin, Mt Hill. lsd = least significant difference. ns = not significant (P>0.05).

Crop type	2023 Wheat			Cumulative GM (\$/ha) **
	Grain Yield (t/ha)	Biomass (t/ha)	Protein (%)	
Canola	5.0	14.1	10.9	2736
Faba Bean	5.0	13.7	10.8	3726
Lentil	4.8	13.8	11.0	2749
Lupin	5.2	15.1	11.8	2688
Vetch	5.1	13.9	11.1	2725
Vetch BM*	5.5	15.1	11.3	1612
lsd	ns	ns	ns	

*BM = brown manured (sprayed off early October), **using 2024 SA Gross Margin Guide

Conclusions and implications

This trial demonstrated that each of the break crops trialled were successfully grown and achieved a profitable gross margin on this soil type (except the brown manured vetch), in an above average growing season rainfall year. The high yielding faba beans realised the highest gross margin. The brown manured vetch treatment retained higher levels of mineral nitrogen (N) in the soil (to 60cm) at the start of the 2023 growing season.

Grain yields of the 2023 wheat crop were all very similar, regardless of the crop planted in 2022 (Table 3). The N fertiliser applied to the wheat in 2023 may have played a role in negating the value of the N fixed. However, given yields were around 5t/ha and each tonne requires access to 40kg N/ha, each plot would have had to have access to 200kg N/ha. Around 40kg/ha (depending on treatment) was present as mineral N in the soil, and 110 kg N/ha was applied (either as urea or starter fertiliser). This leaves a gap of around 50kg N/ha that must have mineralised, regardless of 2022 treatment if the assumption of required kg N/ha is correct.

This trial demonstrated the value of a high performing pulse crop on the two-year gross margin, and helps put into perspective the higher value, but lower yields of lentils, in this situation. In years, such as 2022, where the soil profile was relatively full, following above average summer rainfall, the probability of water logging in lentils increases. The success of growing faba beans in wetter conditions increases, in conjunction with a timely break to the season, that enables faba beans to flower into a window that avoids high levels of heat damage. This trial was able to quantify the value of choosing to grow faba beans, given a number of seasonal conditions, all of which were known prior to seeding.

Authors: Andrew Ware, EP AG Research

Background: This site was an ironstone gravel, neutral to slightly acidic soil pH, in the Edillilie area south of Cummins. The pH was traditionally much lower, but with regular lime inputs over ten years it is now in the range where crops such as lentils and faba beans can be explored. The ironstone gravel nature of the soil results in a low soil water holding capacity. Pulse crops can fail if rainfall is not frequent at periods of high-water demand (e.g. spring).

The area has traditionally only grown lupins and canola as break crops. Higher value pulse crops, such as lentil and faba bean, have the potential to add diversity to the rotation, providing alternative control options for ryegrass and potentially adding profitability across the rotation. However, growers and advisors were interested in better understanding several agronomic factors to improve their confidence of growing pulse in this area.

Rainfall

Av. Annual: 420 mm

2023 Total: 342 mm

Av. GSR: 340 mm

2023 GSR: 268 mm

Soil: Ironstone gravel, red brown early, chromosol, pH (CaCl) 0-10 cm = 6.77

Aim:

1. To determine the relative yield of a range of break crops (pulses) compared to the traditionally grown canola on an ironstone gravel soil, Lower Eyre Peninsula.
2. To determine if treating the lentils with different inoculants will improve crop performance/production.
3. To determine if the application of differing nutritional packages has the potential to improve lentil production on the ironstone gravel soils of Lower EP.

Key messages:

- Lentils can achieve similar or better gross margins to the traditionally grown lupins.
- The rNod test is valuable in using where pulse crops have been grown previously to avoid unnecessarily using higher rates or more expensive forms of inoculant.
- There has been no advantage of applying higher rates of phosphorus or trace elements.

Methodology and results:

1. Crop type

2023 Canola (cv 44Y94CL), Faba Beans (cv PBA Samira), Lentils (cv Thunder), Lupins (cv AGT Wonga), and Vetch (cv Blanchefleur) were planted, using seeding rates and label broadleaf weed control suitable for each crop. Despite the application of insecticide and baiting, most of the canola seedlings were eaten by slaters and/or millipedes, with plots subsequently treated as fallow. All pulses and canola received 100kg/ha MAP at seeding.

Lupins demonstrated they were the best adapted pulse crop to this soil type and environment. However, their lower price resulted in having a similar gross margin to lentils, despite yielding around 1 t/ha more (Table 4).

Table 4. Break crop grain and biomass yield, Edillilie 2023. Data labelled with the same letters within a column are not significantly different (P<0.05).

Crop	Grain yield (t/ha)		Biomass yield (t/ha)		Gross Margin (\$/ha) **
Vetch BM*	0	a	4.4	a	-450
Vetch	0.46	a	4.1	a	-218
Lentil	1.50	b	4.1	a	468
Faba Bean	1.92	b	4.8	ab	220
Lupin	2.45	c	5.9	b	474

*BM = brown manures (sprayed off early October), **using 2024 SA Gross Margin Guide

2. Inoculant

Prior to sowing, an rNod soil test detected levels of Group G (lupin), and Group E and F rhizobia (Faba Bean and Lentil) were already present in the soil, from crops previously grown in the past six years (Table 5).

A range of commercially available inoculants were evaluated (

Table 6), when treated as per label to GIA Thunder lentils, planted at 120 plants/m².

Nodule scoring of lentil roots found there was no difference in root nodules present at the start of flowering (data not shown).

Table 5. rNod soil test results detected levels of Group G and Group E & F rhizobia present in the soil.

Rhizobia Group G & S <i>log (rhizobia)/g soil</i>	Rhizobia Group N <i>log (rhizobia)/g soil</i>	Rhizobia Group E & F <i>log (rhizobia)/g soil</i>
3	0	3

Table 6. Lentil grain yield and final biomass (t/ha) for Edillilie inoculant trial, 2023. Data labelled with the same letters within a column are not significantly different (P<0.05).

Treatment	Grain Yield (t/ha)		Biomass Yield (t/ha)	
Peat_acid x2	1.19	a	3.0	A
Peat_acid	1.24	a	2.8	A
No_inoc	1.30	a	2.9	A
Peat	1.32	a	3.1	A
Granular	1.37	a	3.2	A
Granular x2*	1.39	a	3.2	A

*x2 = twice label rate.

Despite the soil being historically acidic, application of lime to raise the pH to near neutral has resulted in creating an environment where Group E and F rhizobia can survive across seasons. The implications of this are:

- It provides confidence in the rNod test.
- It has the potential to create savings, by not having to apply high rates of inoculant, and/ or more expensive inoculant types (both of these are common practices in this environment).

3. Nutrition

Cereal crops grown on ironstone gravel soils are typically responsive to the application of phosphorous, with the high iron content tying P up in insoluble compounds and similar effects also being observed with some trace elements. Pulse crops are generally also responsive to P applications.

Table 7. Soil test results collected from Edillilie trial site in April, 2023. N/A = sample not tested.

Sample Depth	pH CaCl ₂	Organic C.	Nitrate - N	Amm. - N	Colwell P	PBI + Col P	DGT-P	Fe	Mn	Cu	Zn
		%	mg/kg	mg/kg	mg/kg		µg/L	mg/kg			
0-10	6.77	1.96	23.3	3.0	85	63	165	32	8.8	1.2	4.6
10-30	6.20	N/A	1.7	1.3	N/A	N/A	N/A	N/A	N/A	N/A	N/A
30-60	6.53	N/A	0.4	0.7	N/A	N/A	N/A	N/A	N/A	N/A	N/A
60-100	6.46	N/A	1.1	0.4	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Plots were sown with GIA Thunder @ 120pl/m², treated with Group EF inoculant, and received Basal fertiliser of 100kg/ha MAP at seeding.

Application of additional nutrients, in this case, was not able to demonstrate any improvement of the grain yield of lentils at Edillilie in 2023, despite the soil type having a reputation for having low nutrient holding capacity (Table 8).

Table 8. Grain yield and biomass yield (t/ha) of lentils at Edillilie 2023

Treatment Name	Treatment Details	Grain yield (t/ha)		Biomass yield (t/ha)	
Control	<i>Control:</i> 100 kg/ha MAP at seeding (20 kg/ha P).	1.71	b	3.81	a
High P	<i>High P:</i> Additional 20 kg/ha P at seeding.	1.37	a	3.30	a
High N & Traces	<i>High N:</i> Additional 100kg/ha urea at 3-4 node (prior to rain front). <i>Traces:</i> Applied in two foliar applications 3-4 node and start of flowering.	1.44	a	3.27	a
High P + N & Traces	<i>High P:</i> Additional 20 kg/ha P at seeding. <i>High N:</i> Additional 100kg/ha urea at 3-4 node (prior to rain front). <i>Traces:</i> Applied in two foliar applications 3-4 node and start of flowering.	1.54	ab	3.62	a

CONCLUSIONS AND IMPLICATIONS

Achieving grain legume yields lower than 2 t/ha in a medium-high rainfall environment does not make the crops readily interchangeable with canola on Lower Eyre Peninsula. It is thought that the below average rainfall finish to the season contributed heavily to this, due to the poor water holding capacity of this soil. To achieve higher yields, the type of soil amelioration process, to increase water holding capacity of the soil, and potentially earlier sowing may prove beneficial.

However, this series of trials was able to demonstrate that lentils have the ability to achieve similar or better gross margins to the traditionally grown lupins, the value of using rNod tests where pulse crops have been grown previously to avoid having to use higher rates, or more expensive forms of inoculant, and that there was no advantage in applying higher rate of phosphorous or trace elements at the site where this work was undertaken.