Annual Results Report

2024

Closing the Economic Yield Gap for Grain Legumes in Western Australia

Legumes – Inoculant Demonstration/s

Project code: GGA2110-002SAX

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KEY MESSAGES

List the key messages of the report.

Understanding the effectiveness of different inoculant types in legumes

Dry peat inoculant outperformed liquid inoculant in both faba bean and lupin trials. The assumption is that the better inoculant seed contact was a driving factor in the results. However, it is also important to consider that tag team dry peat has phosphate-solubilising microorganism *Penicillium bilaii* with nitrogen-fixing rhizobia bacteria. Together, they can create more fixed nitrogen and better access to soil and fertiliser phosphate, providing higher yield potential in pulse crops.

Higher yields and better nodulation were observed with the dry peat treatment.

Legume inoculation remains critical for optimizing nitrogen fixation and crop performance in low-rainfall zones.

SUMMARY

Summarise the results.

These trials evaluated the performance of dry peat vs. liquid inoculant in grain legume production in Western Australia. The results show that dry peat inoculant consistently produced higher grain yields and better nodulation scores than liquid inoculant across both faba bean and lupin crops.

Faba Bean Yield:

- Dry Peat: 1.63 T/ha
- Liquid Inoculant: 1.50 T/ha
- Control: 1.47 T/ha

Faba Bean Nodulation Score rating is from one to four with four being excellent below is the average across the site.

- Dry Peat: 3.05
- Liquid Innoculant:2.65
- Control:1.93

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Lupin Yield:

- Dry Peat: 1.99 T/ha
- Liquid Inoculant: 1.84 T/ha
- Control:1.86 T/ha

Lupin Nodulation Score rating is from one to four with four being excellent below is the average across the site

- Dry Peat: 3.03
- Liquid Inoculant: 2.57
- Control: 2.62

#To note: The lupin site had Lupins 3 years prior some bacteria could be still alive in the soil where as the faba bean site has not had a legume on it for 10 years. Noting that is where we see the bigger difference between the inoculants and control.

The results reinforce the importance of selecting the most effective inoculation method for maximizing yield potential and improving soil fertility. There are some assumptions that this is due to better inoculant coverage on the seed compared to the liquid being close to but not covering the seed. With other studies showing the advantage of extra inoculant being beneficial to the legume.

BACKGROUND

Break crops are widely acknowledged as being necessary to manage the biological constraints that reduce cereal crop production. One of the constraints in the use of a single or double break crop sequence is that the Gross Margin of the most used break crops are generally less than growing a cereal crop, especially in the low rainfall zone (LRZ). As a result, break crops are used sparingly by growers in crop rotations with the aim of maintaining the most profitable sequence of crops while maintaining reasonable control of weeds and diseases. The short-term decrease in economic return from growing a break crop is offset by the longer-term benefits of decreased production costs and increase the productivity of cereal crops for many years following.

These demonstrations were carried out to further assess available inoculants for legumes to compliment the small plot trial and other demonstrations for the grain legume project. Making correct choices with inoculants can help to close the economic gap, with larger yields for the legume and more N fixation for the following crop a large benefit.

OBJECTIVES

What are the objectives of the trial/experiment? What is intended to be achieved in carrying out the trial/experiment?

Other trials for the grain legume project sought to determine profitable break crops for the CFIG low rainfall zone region.

These demonstrations added further information regarding yield response to dry peat and liquid inoculants. These responses will help farmers be better informed if they choose to go down the legume path on how they best adapt it to their farming system. Many farmers are unsure on where and when to plant legumes finding them delicate. Inoculants help the root system of the legume to be able to thrive in its environment.

METHODS

How was the trial/experiment conducted? Avoiding overly technical language, describe the way the project has approached the task.

Large-scale demonstration sites were conducted in the South Corrigin area to highlight to growers the importance of inoculating their pulse crops.

Demonstration site One included two product application comparisons dry peat and liquid inoculant) against a nil applied control treatment. In a Faba Bean crop where legumes have not been used for many years.

Demonstration site Two demonstrated the difference between two peat products (dry and liquid inoculant) This was in a two year wheat and one year lupin system so the rotation was more helpful to the bacteria surviving in this system.

RESULTS

What happened? Provide a description of the results from the work so far and some interpretation of what these mean in terms of farm practice or modified approaches to the underlying issue when interpreted for on-farm use. This can include graphs and photos.

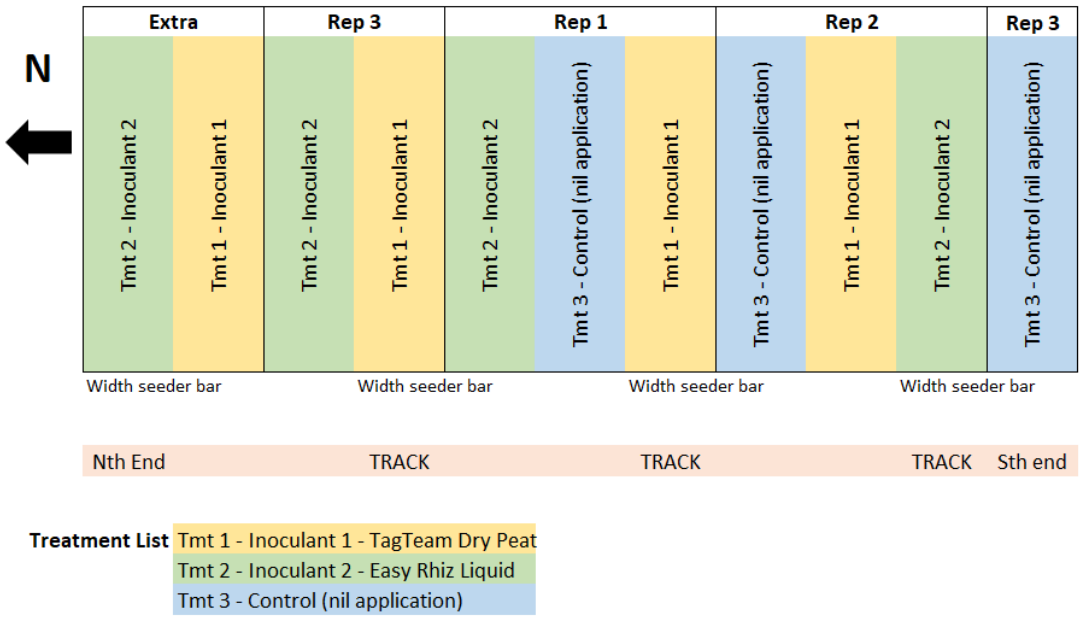
The following results topics need to be addressed and can be used as sub-headings. If the measurements were not completed, state why that was the case.

Please include relevant climate data and a schedule of site management activities

- Paddock history
- Stubble cover - not measured as not relevant to demonstration
- Site characterisation
- Soil and plant nutrition analysis - not measured as not relevant to demonstration
- Soil moisture at seeding and harvest - not measured as not relevant to demonstration
- Predicta B results
- Crop establishment and weed counts - not measured as not relevant to demonstration
- Crop disease assessment results
- Nodulation score
- Grain quality
- Yield measurements
- Statistical and economic analysis
- Provide evidence of your extension and communications activities including any metrics on engagement

1. Experiment 3 – Faba Bean Inoculant Demonstration Site – Corrigin WA (C. Baker)

Parameter	Description
Essential site characteristics (Please check site prior to commencement).	Soil type can vary if seeding long runs (greater than 200m) however must not have subsoil constraints that restrict crop growth. Acidic soils are not typically conducive to pulse crops – however new rhizobium allowing for slightly more tolerance to previous years. Nil tolerance of residual herbicides.
Site Structure	Grower demonstration site.
Replication	three replications/runs
Plot length	100m (minimum)
Plot width	Seeding Bar Width – 14.02m
Previous Crop:	*Rotation:* 2024 – Faba Beans (Marne) 2023 – Oats 2022- Canola Trident (TT)
Treatments	Inoculant product 1 – TagTeam Peat (Group E/F) Inoculant product 2 – Easy Rhiz Liquid (Group F) Control – No Inoculant on seed. *Note: Naming of products in protocols for documentation records – will be removed for communication of results etc.*
Input Rates	2024: Seed 120kg/ha – Marne Faba Beans Fertiliser 70kg - NKP CZ blend Inoculant Group E/F



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Grain Quality Table Faba Beans

i.e PLOT 1	i.e Full or infratec only	Protein	Moisture	Temp	Weight (g	Other seed/Format (gms)	Other seed/Format (%)	Shrivelled/distorted (gms)	Shrivelled/distorted (%)	SFS (gms)	SFS (%)	Sand, Rocks	Unmillable	Other See	Poor Colo	Damaged
CBD - 1	Full Analysis	28.2	8		200	0.84	0.42	5.86	2.93		0		1.2	3		8.64
CBD - 2	Full Analysis	28.2	8.1		200	0.81	0.405	3.31	1.655		0		0.22	5	1.18	9.62
CBD - 3	Full Analysis	28.4	8		200	1.43	0.715	3.01	1.505		0		0.34	9	1.1	9.07
CBD - 4	Full Analysis	27.1	8.2		200	3.5	1.75	3.45	1.725		0		0.16	16		14.41
CBD - 5	Full Analysis	28.6	8		200	0.93	0.465	6.91	3.455		0		0.84	5		8.83
CBD - 6	Full Analysis	28.2	8		200	1.69	0.845	4.26	2.13		0		0.56	7		7.15
CBD - 7	Full Analysis	27.2	8.2		200	0.41	0.205	3.94	1.97		0		0.25	3	0.34	7
CBD - 8	Full Analysis	28	8		200	0.51	0.255	2.03	1.015		0		0.29	3		11.37
CBD - 9	Full Analysis	26.6	8.2		200	3.52	1.76	3.5	1.75		0		0.61	16		7.96
CBD - 10	Full Analysis	27.9	7.9		200	0.94	0.47	1.64	0.82		0		0.5	6	0.7	8.97
CBD - 11	Full Analysis	27.8	8		200	0.32	0.16	2.84	1.42		0		0.57	2		8.18

Above is the CBH results of the grain quality of the faba beans per each site

Economic Analysis

Location	South Corrigin, WA Connor Baker Faba Bean	
Plot size & replication	Farmer Demo - 3 replicates, randomised.	
Paddock rotation	2021: Barley (Planet) 2022: Canola Trident (TT) 2023: Oats (Bannister) 2024:Faba Bean (Marne)	
Soil type	Red Loamy Clay	
Soil pH ($CaCl_2$)	0-10cm: 5.5 10-30cm: 5.6	
Sowing date	13/4/24	
Sowing rate	Faba Bean (Marne) 120kg/ha	
Fertiliser	CBH NPK 70kg/ha	**$73.50 per ha**
Inoculant	Tag Team Dry Peat applied to cover seed through auger Easy Rhiz Liquid inoculant applied through vial into furrow	= $10 per ha =$10 per ha
Herbicides, insecticides & Fungicides	*Pre-emergent:* Glyphosate (450g/l) 1 L/ha, Ecopar 0.10 L/ha, Simazine WG 0.50kg/ha, Diuron WG 0.50kg/ha, propyzamide liquid (500g/L) 1.00 L/ha, Chlorpyrifos 0.30 L/ha, Wetter 1000 @0.20% and ammonium sulphate @1% =	**$39.86 per ha**
	4-5 Leaf Stage: Select (Clethodim 360g/L) 0.70 L/ha, Factor 0.18kg/ha, Targa(100 g/L) 0.20 L/ha, Mancozeb 1.00kg/ha, Hasten@ 1% and ammonium Sulphate @ 1% =	**$30.24 per ha**
	Flowering: Carbendazim (500g/l) 0.50L/ha, Alpha cypermethrin (100g/l) 0.30L/ha, Chlorpyrifos 0.30 L/ha =	**$13.90 per ha**
Diesel/Labor		**$50.00 per ha**
Faba Bean per T	**$590**	
	Control = 207.50 + (1.47 x 590) =	**$659.80 per ha**
	Dry Peat = 217.5 + (1.63 x 590) =	**$744.20 per ha**
	Liquid = 217.5 + (1.50 x 590) =	**$667.50 per ha**
Machinery		

Annual rainfall	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sept**	**Oct**	**Nov**	**Dec**	**Total**
	11	22	54	0	38.6	41.4	79.2	71	28	8.6	23.8	6.8	384

Growing season rainfall (April-October) 267mm

2. Experiment 4 – Lupin Inoculant Demonstration Site – Corrigin WA (additional site) (C.Baker).

Parameter	Description
Essential site characteristics (Please check site prior to commencement).	Soil type can vary if seeding long runs (greater than 200m) however must not have subsoil constraints that restrict crop growth. Nil tolerance of residual herbicides. Acidic soils are not typically conducive to pulse crops – however new rhizobium allowing for slightly more tolerance to previous years.
Site Structure	Grower demonstration site.
Replication	Minimum of three replications/runs.
Plot length	100m (minimum).
Plot width	Seeding Bar Width – 14.02 m.
Previous Crop:	*Rotation:* 2024 – Jurien Lupins. 2023 – Wheat (1.8t/ha average yield). 2022 – Wheat (3t/ha average yield).
Treatments	Inoculant product 1 – TagTeam Peat (Group G). Inoculant product 2 – Easy Rhiz Liquid (Group G). Control – No Inoculant on seed. *Wetter: SE14 Liquid applied at seeding.* *Note: Naming of products in protocols for documentation records – will be removed for data reporting of results etc.*
Input Rates	2024: Seed 100 kg/ha – Lupins (Jurien). Fertiliser 70 kg/ha NPKCZ Inoculant Group G Seed Coating Rovral

Grain Quality Results Lupins

i.e PLOT 1	i.e Full or infratec	Protein	Moisture	Temp	Weight (gms)	Other seed/For mat (gms)	Other seed/For mat (%)
Connor Baker L Demo							0
Rep 1.1 - TMT 1 Dry Peat	Full Analysis	33.8	8.7	25	200.01	4.35	2.175
Rep 1.2 - TMT 2 Easy Rhiz	Full Analysis	33.8	8.7	26	200.04	3.27	1.635
Rep 1.3 - TMT 3 Control Nil	Full Analysis	33.6	8.7	23	200.09	0.65	0.325
Rep 2.1 - TMT 2 Easy Rhiz	Full Analysis	34.5	8.7	25	199.98	0.76	0.38
Rep 2.2 - TMT 1 Dry Peat	Full Analysis	34.7	8.7	24	199.99	0.77	0.385
Rep 2.3 - Control Nil	Full Analysis	35	8.7	23	200.01	1.38	0.69
Rep 3.1 - TMT 1 Dry Peat	Full Analysis	33.8	8.8	24	200.02	1.46	0.73
Rep 3.2 - Control Nil	Full Analysis	34.3	8.7	24	200.11	1.58	0.79
Rep 3.3 - TMT 2	Full Analysis	34.8	8.7	25	200	3.84	1.92

Please see above Grain Quality per site analysed by CBH

Economic Analysis

Location	South Corrigin, WA Connor Baker Lupins	
Plot size & replication	Farmer Demo - 3 replicates, randomised.	
Paddock rotation	2021: Lupins (Jurien) 2022: Wheat (Calibre) 2023: Wheat (Calibre) 2024:Lupins (Jurien)	
Soil type	White non wetting sand with gravel seams	
Soil pH ($CaCl_2$)	0-10cm: 5.6 10-30cm: 4.8	
Sowing date	9/5/24 Time of Sowing	
Sowing rate	Lupins (Jurien) 100kg/ha	
Fertiliser	CBH NPK 70kg/ha	**$73.50 per ha**
Inoculant	Tag Team Dry Peat applied to cover seed through auger Easy Rhiz Liquid inoculant applied through vial into furrow	= $10 per ha =$10 per ha
Herbicides, insecticides & Fungicides	*Pre-emergent:* Glyphosate (450g/l) 1 L/ha, Ecopar 0.10 L/ha, Simazine WG 1.50kg/ha, propyzamide liquid (500g/L) 1.00 L/ha, Metribuzin DF 0.30 kg/ha, Chlorpyrifos 0.30 L/ha, Wetter 1000 @0.20% and ammonium sulphate @1% =	**$48.81 per ha**
	2-3 Leaf Stage: Brodal Options	**$6.00 per ha**
	4-5 Leaf Stage: Select (Clethodim 360g/L) 0.70 L/ha, Factor 0.18kg/ha, Targa(100 g/L) 0.20 L/ha, Hasten@ 1% and ammonium Sulphate @ 1% =	**$23.04 per ha**
Diesel/Labor		**$50.00 per ha**
Lupins per Tn	**$500**	
	Control = 201.35 + (1.86 x 500) = $728.65 per ha **Dry Peat = 211.35 + (1.99 x 500) = $783.65 per ha** **Liquid = 211.35 + (1.84 x 500) = $708.65 per ha**	
Machinery		

Annual rainfall	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Total
	11	22	54	0	38.6	41.4	79.2	71	28	8.6	23.8	6	384

Growing season rainfall (April-October) 267mm

Economic Analysis

Lupins

Control = 201.35 + (1.86 x 500) = $728.65 per ha
Dry Peat = 211.35 + (1.99 x 500) = $783.65 per ha
Liquid = 211.35 + (1.84 x 500) = $708.65 per ha

Faba Beans

Control = 207.50 + (1.47 x 590) = $659.80 per ha
Dry Peat = 217.5 + (1.63 x 590) = $744.20 per ha
Liquid = 217.5 + (1.50 x 590) = $667.50 per ha

The Dry Peat averaging close to $70 per ha over the 2 trials showed the importance of a good inoculant where something like the tag team has phosphate-solubilising microorganism *Penicillium bilaii* with nitrogen-fixing rhizobia bacteria, this in combination with good seed contact planted in correct conditions.

Showed in the end yield with a higher profit margin in the dry peat. What is missing from this economic analysis is that the extra nitrogen for the crop growing the year following will also add to this economic benefit.

CONCLUSIONS

This study highlights the economic and agronomic benefits of dry peat inoculant over liquid inoculant for both faba beans and lupins in low-rainfall conditions. The results provide strong evidence that growers should prioritize dry peat inoculants for better yield outcomes and improved nitrogen fixation.

RECOMMENDATIONS FOR GROWERS

- Choose dry peat inoculant for better yield and nodulation.
- Ensure proper inoculant application to maximize legume benefits.
- Monitor nodulation success to optimize nitrogen fixation.

COMMUNICATIONS AND EXTENSION

1 Field Day Events

CFIG Spring Field Day 17th September 2024

The start of the Spring Field day following the welcome led into Joy Valle EO at CFIG giving an update on all projects including the Grain Legumes Project. An overview of the project was given on the Grain Legume project "Closing the Economic Yield Gap of Grain Legumes in WA". (1 small plot trial and 2 contracted farmer demonstration sites with additional information gathered from other unofficial demonstration sites also.

We had a field walk as part of the overall Spring Field Day to Connor Bakers Legume Innoculant site attended by a good amount of producers and discussions held around the findings.

We later had a Field Walk Project Update in the CFIG Quarterly Spring Newsletter

The group bussed it to the Baker family's farm to check out the last stop of the day, a faba bean trial looking at different innoculants, dry peat, liquid easy rhiz and no innoculant. This is project 'Closing the Economic Yield Gap of Grain Legumes in WA' is made possible with investment by the GRDC, and supported by GGA. Connor Baker noted there were small differences, however the lasting effects may not be seen until following year. He also spoke about the marketing of faba bean varieties and the advantages and challenges associated with growing them in the Corrigin area. He walked and talked the group through his observations and challenges of a double break using a faba bean followed by a canola crop. The double break allowed the Bakers to clean the 'dirty' paddocks farmers experience trouble with.

The successful CFIG Spring Field Day was topped off by a sundowner at the Corrigin Hotel where many locals had the opportunity to further the many discussions held throughout the day. CFIG would like to sincerely thank all of our guest presenters, project funders and partners, sponsors, growers, committee and industry representatives for their important contributions to this event.

2 Social media

Facebook – Spring Quarterly circulated with Project Updates

https://www.facebook.com/share/p/1JtPPpHpb5/

PHOTOS

Figure 1 CFIG Members at legume demo site on field walk

Figure 2 Connor Baker talking to members about inoculants on field walk

Figure 3 Attendees inspecting the Faba beans.

Small video with Connor Baker starting off the discussions at legume demonstration site. Please request link if needed.

REFERENCES AND USEFUL LINKS

Provide a list of key publication references and web links relevant to the project and for further exploration of the topic.

grdc.com.au › data › assets NEW GROUP F RHIZOBIA INOCULANT FOR FACT SHEET - Grains Research...

FACT SHEET - University of Adelaide

7:41 youtube.com Demonstrating Faba bean inoculant and agronomy to enhance yield, hasten maturity, and reduce disease 18 Aug 2021 334 views

A multi site field evaluation of granular innoculants for legume nodulation

Optimising the growth and nitrogen fixation of legumes through the use of improved rhizobia strains

Inoculating Legumes - University of Adelaide

Inoculating legumes: practice and science - GRDC

Optimising performance from rhizobial inoculants for pulse crops