Annual Results Report

2025

Closing the Economic Yield Gap for Grain Legumes in Western Australia

Project code: GGA2110-002SAX

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Corrigin Farm Improvement Group

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Contents

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GRAINS RESEARCH & DEVELOPMENT CORPORATION ABN 55 611 223 291

KEY MESSAGES

List the key messages of the report.

- Local growers gained a better understanding of legumes suitable in the Eastern Wheatbelt
- Legumes have a role in low rainfall farming systems
- Direct comparison of yields for Lupins, Field Peas, Vetch and Chickpea

SUMMARY

Summarise the results.

The 2024 Narembeen legume trial provided valuable insights into the performance of different break crops under low rainfall conditions. The standout result was field peas achieving the highest average yield of **1.15 t/ha**, followed by lupins (**0.90 t/ha**), chickpeas (**0.55 t/ha**), and vetch (**0.50 t/ha**). The chemical fallow did not produce a yield but played a role in soil moisture conservation.

The trial demonstrated that field peas were the most productive option, indicating their suitability for low rainfall areas. Lupins also performed well, reinforcing their viability as a break crop. Chickpeas and vetch had lower yields, suggesting that their agronomic fit may require further optimization.

Subsequent wheat crop yields following different break crops are:

- Field Pea Stubble: 3.48 t/ha (Highest yield)
- Chickpea Stubble 3.43 t/ha
- Chemical Fallow: 3.39 t/ha
- Vetch Stubble: 3.33t/ha
- Lupin Stubble: 3.23 t/ha (Lowest yield)

To note previous years trial was missing legume yields as rogue cows grazed the site. So, this yields wheat on previous legumes can be seen as influenced. Overall assumption is that nitrogen was fixed when cows grazed site.

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 commonly 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.

The most desired traits of a break crop are to be highly effective in controlling weeds and disease while also being highly profitable. The downside of high value legumes such as chickpeas are that potentially these break crop options have less developed (and therefore less effective) weed and disease management packages for the WA environment. The timing of fungicide applications also raises concerns for growers with achieving effective applications to manage disease loading.

OBJECTIVES

The CFIG component of the grain legume project over 2023 and 2024 was to compare the yield potential for five grain legume crops in our area and assess the impact on wheat yield in the following year. The small plot trial assessed Lupins, Field Pea, Vetch, chem fallow and Chickpea. These legumes are seen as viable options for the Narembeen area and have been used in this trial for this comparison.

METHODS

A small plot trial was established in Narembeen WA in the Low rainfall zone (LRZ) of the wheatbelt that covers the main soil type in the region where break crops and high value legumes can be grown (Treatments: Table 1. Site layout: Figure 1). CFIG were responsible for co-ordinating the activities of the site with the host farmer, service providers (Living Farms), data collection, and communication of outcomes of the project to the local region. The management of the trial site aligned with the host growers' current practices, and was sown, sprayed and harvested with service providers. Small plot trial machinery and all treatments were replicated for statistical rigour.

Table 1. Narembeen small plot trial treatments

Treatment Number	Treatment	Crop Variety
V1	Chickpea	Striker
V2	Field pea	Kasper
V3	Lupin	Jurien
V4	Vetch	Volga
V5	Chemical Fallow	-

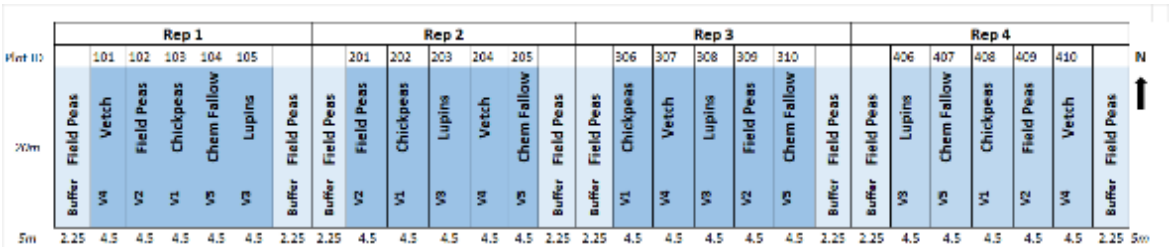


Figure 1. Narembeen small plot trial layout 2024 with 4 reps of complete randomised blocks. Rep 4 was seeded without inoculant for demonstration and extension purposes.

Soil tests were conducted at the beginning of the season to determine the soil water content and to assess the nutrient requirements and presence of any chemical barriers in the soil (e.g. acidity, nutrient toxicity). The seeding rates and type of fertiliser used were implemented as per current grower practice for the region.

The collection of in-season crop production data was completed using standardised sampling procedures to enable the data to be analysed for significant differences. However, the grower group experienced a large staff change around halfway through the year with minimal handover for all projects which meant some data was missed.

RESULTS

- Paddock history, Input Summary & Site Characterisation

Table 2 Paddock history, sowing details, inputs and site characterisation for Narembeen small plot trial 2024

Location	Narembeen, WA
Plot size & replication	Small Plot - 4 replicates, randomised. Plot size: 20m x 4.5m
Paddock rotation	2021: Chemical fallow 2022: Cutubury Canola (TT) 2023: Wheat 2024: Legume trial
Tillage type	Minimum tillage
Soil type	Brown Sandy Loam
Soil pH ($CaCl_2$)	0-10cm: 5.9 10-30cm: 7.2 30-50cm: 6.1
Soil moisture, depth (cm)	Poor (>5 cm)
Clod size	Medium (5-10 cm)
Seed bed	Standing stubble (stubble loading 10-20%)
Sowing date	28/05/2024
Sowing equipment	Knife points and press wheels (sowing depth 20-25 mm, row spacing 25.4 cm)
Sowing speed	4 km/hr
Sowing rate	Chickpea (Striker): 80 kg/ha Field pea (Kasper): 80 kg/ha Lupin (Jurien): 80 kg/ha Vetch (Volga): 20 kg/ha
Fertiliser	MAP 40 kg/ha
Herbicides, insecticides & fungicides	*Pre-emergent:* Trifluralin 2 L/ha Weedmaster DST 2 L/ha Rustler 1 L/ha Bifenthrin 100 mL/ha Chlorpyrifos 1 L/ha *Post-emergent:* Clethodim 330 mL/ha Elantra Xtreme 100 mL/ha Aviator Xpro 600 mL/ha Transform 50 g/ha Affirm 300 mL/ha Transform 50 g/ha Affirm 300 mL/ha
Machinery	Plot seeder, Plot sprayer, Plot harvester
Farmgate prices	
Chickpea per T	$750 750 x 0.55 = $412.5
Field Pea per T	$550 550 x 1.15 = $632.5
Lupin per T	$450 450 x 0.90 = $405
Vetch per T	$550-$650 600 x 0.50 = $300

Rainfall	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Total
	17.8	29.4	69.2	0	5.6	39.4	85.0	41.2	14.6	7.8	18.6	13.2	341.8

Annual rainfall	Growing season rainfall (April-October) 193.6 mm

• Soil and plant nutrition analysis

Table 3 Pre-seeding soil analysis results for Narembeen small plot trial

Lab No.	2ASS24029	2ASS24028	2ASS24027
Longitude Latitude	118.290325328708, -32.0569761994136		
Depth	0-10	10-30	30-50
Texture	2.5	3.0	3.0
Colour	BRYW	GRYW	LTBR
Gravel (%)	5-10	15-20	10-15
NO3 (mg/kg)	32	2	2
NH4 (mg/kg)	1	1	1
OC (%)	1.11	0.19	0.33
P (mg/kg)	35	6	6
PBI	46.2	79.5	113.7
K (mg/kg)	153	50	43
S (mg/kg)	11.0	28.0	37.6
pH	5.9	7.2	6.1
pH H_2O	6.4	7.7	6.5
EC (dS/m)	0.133	0.216	0.116
Ca - exch (meq/100g)	3.47		
Mg - exch (meq/100g)	1.16		
Na - exch (meq/100g)	0.12		
K - exch (meq/100g)	0.36		
Al - exch (meq/100g)	0.038		
Cu (mg/kg)	0.41		
Zn (mg/kg)	0.71		
Mn (mg/kg)	3.22		
Fe (mg/kg)	25.10		
B (mg/kg)	1.32		
Moisture % (%)	5.59		

• Soil moisture at seeding and harvest

Soil moisture at harvest was not recorded.

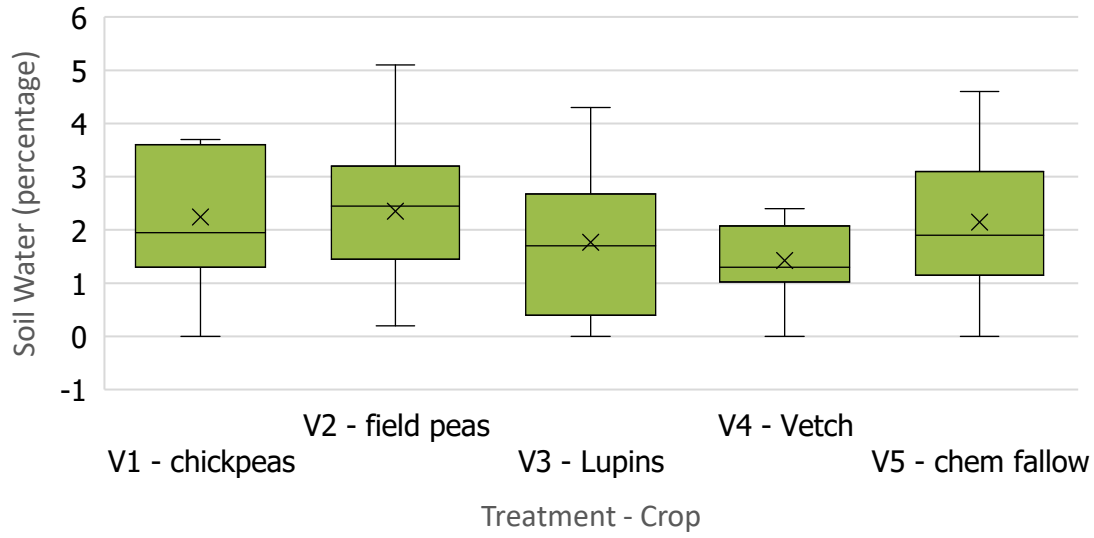


Figure 3 Soil moisture (percentage of soil volume) in the top 10 cm of sample plots at seeding

- **Predicta B results**

Predicta B results reported low pathogen (Rhizoctonia, Crown Rot and *P. neglectus*) loading. Screenshots of results pasted below.

GRDC

PREDICTA B
DNA Soilborne disease tests

Molecular Diagnostic Centre
Gate 2A, Hartley Grove
URRBRAE SA 5064
Ph 08 8429 0290

Sample: **AAJ1854**

Grower:	**D COLE**
Paddock:	**RISKWISE**
Nearest town:	**CORRIGIN**
Region:	**WESTERN**

Report date:	**02/08/2024**
Date sampled:	
Dry weight (g):	**548**
Sample condition:	**Damp**
Core depth:	
Sampling strategy:	
Stubble added:	**Not Specified**

Paddock history	**2 years ago**	**Last year**	**This year**
Crop / variety			

TEST	RESULT		DISEASE RISK* (Not Detected / Low / Med / High)
CCN	<0.1	eggs / g sample	
Stem nematode	<0.5	nematodes/100 g sample	
Take-all	<0.8	log(pg DNA/g sample)	
Take-all - Oat Strain	<0.8	log(pg DNA/g sample)	
Rhizoctonia	1.3	log(pg DNA/g sample)	
Crown rot	0.3	log(pg DNA/g sample)	
Pratylenchus neglectus	3.0	nematodes / g sample	
Pratylenchus quasitereoides	<0.1	nematodes / g sample	
Blackspot	<1.2	log(pg DNA/g sample)	
Blackspot (Phoma koolunga)	<1.2	log(pg DNA/g sample)	

*Risk categories should be used as a guide only, may be subject to regional and seasonal differences, and may be revised over time.

UNDER EVALUATION

TEST	RESULT		POPULATION DENSITY** (Not Detected / Low / Med / High)
Common root rot	<0.6	log(pg DNA/g sample)	
Pythium clade f	1.1	log(pg DNA/g sample)	
Yellow leaf spot	<0.3	log(kDNA copies/g sample)	
Eyespot	<0.3	log(kDNA copies/g sample)	
White grain disorder	<0.3	log(kDNA copies/g sample)	
Pratylenchus penetrans	<0.1	nematodes / g sample	
Pratylenchus thornei	<0.1	nematodes / g sample	
Charcoal rot	2.3	log(kDNA copies/g sample)	
Ascochyta blight of chickpea	<0.1	log(kDNA copies/g sample)	
Sclerotinia sclerotiorum/S. minor	<0.1	log(kDNA copies/g sample)	

**Population densities are based on the pathogen levels detected in PREDICTA samples across the industry. These are not disease risk categories.

PREDICTA B
DNA Soilborne disease tests

Molecular Diagnostic Centre
Gate 2A, Hartley Grove
URRBRAE SA 5064
Ph 08 8429 0290

Sample: **AAJ1854**

Grower:	**D COLE**
Paddock:	**RISKWISE**
Nearest town:	**CORRIGIN**
Region:	**WESTERN**

Report date:	**02/08/2024**
Date sampled:	
Dry weight (g):	**548**
Sample condition:	**Damp**
Core depth:	
Sampling strategy:	
Stubble added:	**Not Specified**

Paddock history	**2 years ago**	**Last year**	**This year**
Crop / variety			

Pathogen comments

Low Rhizoctonia: Prevent weeds establishing after break to minimise inoculum multiplication prior to seeding. If paddock has a history of Rhizoctonia, cultivation prior to seeding, sowing early & adequate Zn, N and P will help reduce yield losses.

Low risk P. neglectus: Yield losses range from 0 - 10%. Select tolerant varieties

Low Crown Rot: losses in bread wheat should not exceed 5%, risk greater in durum wheat

Agronomist	Mobile	Accreditation number
Valle, Joy		3732

PREDICTA Rhizobia test rNod

Molecular Diagnostic Centre
Gate 2A, Hartley Grove
URRBRAE SA 5064
Ph 08 8429 2243

Sample:	**RNC1397**		
Grower:	**D COLE**	Report date:	**08/08/2024**
Paddock:	**RISKWISE.**	Date sampled:	**01/01/0001**
Nearest town:		Dry weight (g):	**322**
Region:	**SOUTHERN**	Sample condition:	**Damp**
		Core depth:	

Pulse/legume history	Group E & F*	Chickpea	Lupin/serradella	Mungbean
Year last grown eg 2015:				

*Group E & F crops include faba bean, lentil, field pea, vetch and lathyrus

Intended crop	**Soil pH(Ca):**	**Soil texture**
	5.35	Sandy loam

BENEFICAL ORGANISMS	**RESULT**		Inoculation Requirement** High / Medium / Low / Nil
Rhizobia Group E & F	<2.3	log(rhizobia)/g sample	
Rhizobia Group G & S	2.9	log(rhizobia)/g sample	
Rhizobia Group N	<2.3	log(rhizobia)/g sample	

**Inoculation requirement categories may vary between regions and seasons, and may be revised over time.

Comments on results:

Rhizobia Group E & F was not detected, apply inoculant if planning to grow faba bean, lentil, field pea or vetch, apply double inoculation rate if pH (Ca)<5.5.

Rhizobia Group G & S was detected at a low level, applying inoculant may be beneficial if planning to grow lupin or serradella.

Rhizobia Group N was not detected, apply inoculant if planning to grow chickpea, apply double inoculation rate if pH(Ca)<5.5.

Crop establishment and weed counts

Mean crop establishment was higher in field peas and lupins than chickpeas or vetch (figure 4). The degree of crop establishment for lupins varied across replications more than the other legumes. Overall based on DPIRD research in the past, chickpeas should be 30-35 plants per square metre, field peas 35-45 plants per square metre, Lupins 40-50 plants per square metre, Vetch (depends on if harvesting or using for hay) 45-65 plants per square metre. Based off these numbers plant establishment was good except for the vetch being slightly light.

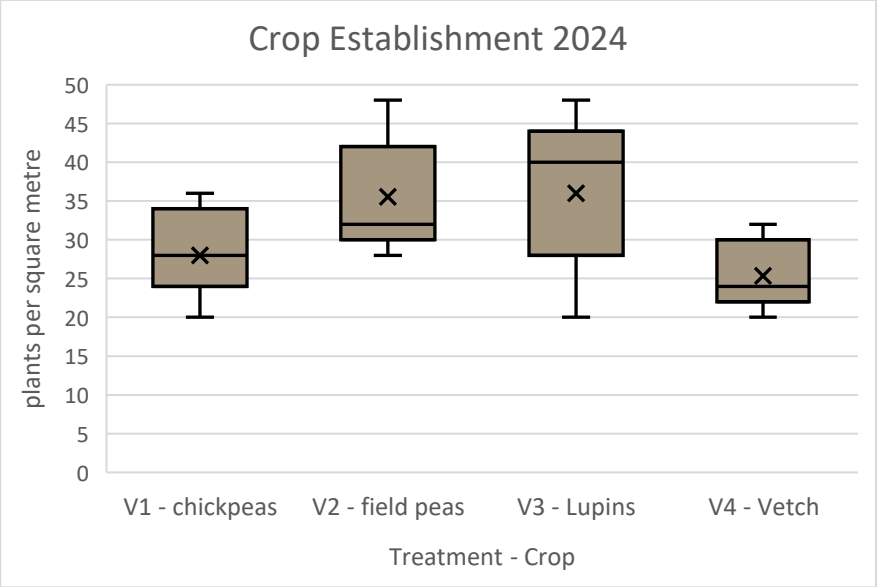


Figure 4 Crop establishment (plants per square metre) for each treatment crop; showing minimum, maximum, mean ('x') and median

Weed loading (figure 5) was evenly low for all treatments apart from chemical fallow. This shows the importance of crop competition when fighting weeds. A later weed count in the season would have been beneficial to see which competed best. Overall site was very clean and well looked after by living farms.

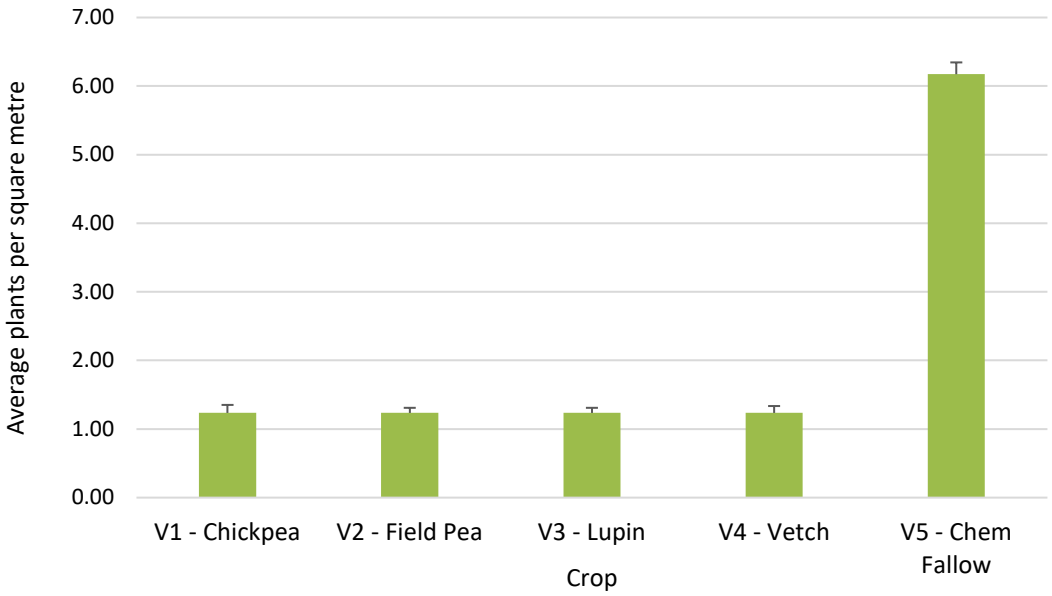


Figure 5 Average weed counts per square metre for each legume treatment crop

- **Crop disease assessment and nodulation.**

The CFIG team (Connor Baker and David Storer) assessed the nodulation within the plots later in the season, all had good visual nodulation and the trial was disease free having been sprayed one week prior to field work.

- **Grain quality**

Of the three legume types tested for grain quality (table 4), the lupin used in the trial (Jurien variety) contained the highest average protein. Unfortunately, vetch sample results were ordered with the rest of the results but were not received.

Table 4 Grain quality results from CBH Analysis. Vetch analysis was ordered but not received.

Treatment No.	Treatment	Crop Variety	Ave. Protein	Ave. Moisture
V1	Chickpea	Striker	18.60	9.40
V2	Field pea	Kasper	21.68	9.05
V3	Lupin	Jurien	31.85	8.78
V4	Vetch	Volga	NA	NA
V5	Chemical Fallow	-	-	-

- **Yield measurements**

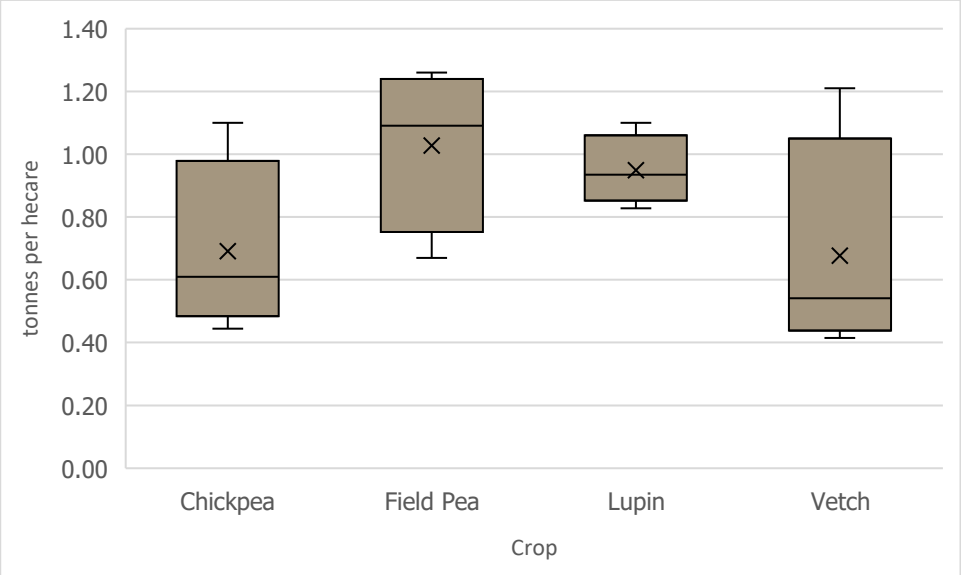


Figure 6 Box and whisker plot displaying range, mean (x) and median yield (tonnes per hectare) harvested from the different legume crops in 2024 at Narembeen small plot site

Table 5 Economic analysis equations

Farmgate prices										
Chickpea per T	$750	750 x 0.55 = $412.5 - $200 = $212.5								
Field Pea per T	$550	550 x 1.15 = $632.5 - $200 = $432.5								
Lupin per T	$450	450 x 0.90 = $405 - $200 = $ 205								
Vetch per T	$550-$650	600 x 0.50 = $300 - $200 = $100								
Chem Fallow	$40									
Wheat on Legume stubble		Commodity Price			Difference in Wheat Yield					
Chickpea		$300			300 x 0.20 = $60					
Field Pea		$300			300 x 0.25 = $75					
Lupin		$310			310 x 0 = 0					
Vetch		$300			300 x 0.1 = $30					
Chem Fallow		$300			300 x 0.16 = $48					
Average over 2 years :		Field Peas: $507.5		Chickpea: $272.5		Lupin: $205		Vetch: $130		Chem Fallow: $8

The above are assumptions based on chemical price, labour and diesel. Overall, the field peas show a cost benefit in the rotation for both years, and that chem fallow should be debated quite heavily as it is a tool for storing moisture and reducing weed issues, however if the year is promising, it may not be as beneficial as it may seem. Also to note the wheat on lupin stubble achieved a higher protein and due to this a higher quality segregation. This was reflected in the pricing of $10 extra. To note that a control of wheat on wheat would be beneficial as a control to see what advantage the lupins had in year two. Volatility in legume grain market will see these prices shift heavily and thus the end profit margin.

CONCLUSIONS

Provide a summary of findings, including implications and future activities.

Outcomes:

Field Peas offer the best break crop option in the Narembeen area in terms of both their high yield (1.15 t/ha) and the highest wheat yield benefit the following year (3.48 t/ha) highlighting the importance of choosing break crops based on long-term profitability, not just short-term yield outcomes.

Future trials should see wheat on wheat provided to see the true amount of nitrogen/yield penalty from a cereal crop to a legume crop. To consider the longer lasting effects of the legume in the soil, fertiliser companies have trialled lupins and are seeing positive results up to three years in advance. A true trial on legumes needs to see three to five years of a true grower system. This will be beneficial to a grower as they will not reason based off short term results.

COMMUNICATIONS AND EXTENSION

1 Field Day Events

CFIG Spring Field Day 17th September 2024

Joy Valle EO at CFIG gave an update 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). The main grain legumes trial site being a comparison of yield potential for differing grain legume crops in the region.

Figure 2 CFIG Spring Field Day Flyer

Figure 3 Grain Legumes Project discussed via at start of field day

The main field walk for the Grain Legumes Project occurred via our Narembeen Field Walk held on the 19th of September 2024.

Back at our first site, where CFIG's RiskWi$e, Time of Sowing and Grain Legume project and trial plots are located at Dylan Cole's Narembeen property, Grower Group Alliance (GGA) project manager Dr Daniel Kidd attended as a guest speaker and spoke about the grain legumes and other projects.
He said the information they have is that all growers want and need legumes in their system in some form or another, but ultimately for farmers it came down to return on investment, particularly regarding price and variations.

Figure 4 Narembeen Field Walk Flyer

We later had a Harvest - Project Update in the CFIG Quarterly Spring Newsletter

CFIG'S HARVEST HAPPENINGS

NAREMBEEN GRAIN LEGUME PLOTS

Lopping off Legumes with Living Farm

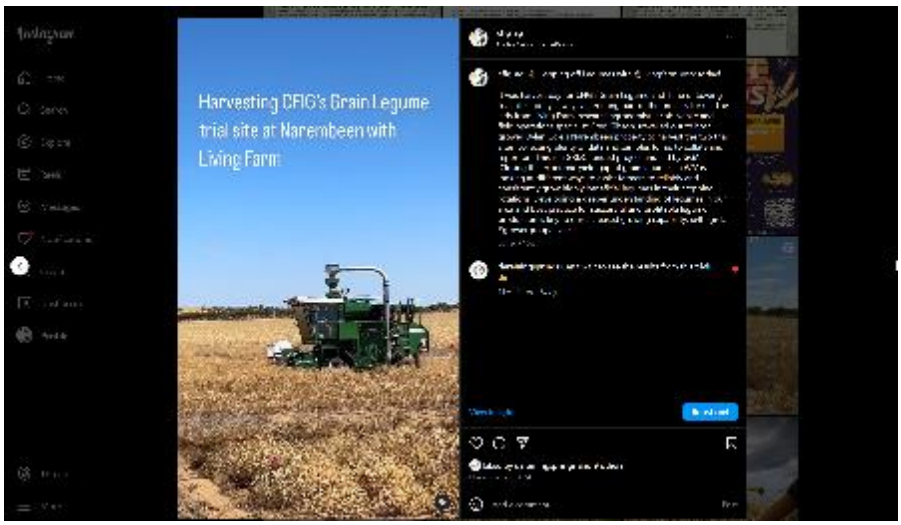
It was harvest day for CFIG's Grain Legume and Time of Sowing trial sites recently, always an exciting part of the process for us! The lads from Living Farm, research agronomist Jacob Nenke and field operations specialist Greg Gibson, travelled out to host grower Dylan Cole's Narembeen property to harvest the two trial sites, collecting plenty of data and samples for us to collate and report on.

This is a GRDC funded project and led by GGA. The 'Closing the economic yield gap of grain legumes in WA' project looks at different ways to assist farmers to reliably and consistently grow highly beneficial legumes in their cropping rotations. Developing a deeper understanding of legumes in our area and best practice for successful and profitable legume production is key to our increased growing capability.

Figure 5 Narembeen Field Walk at Grain Legumes site update in CFIG Spring Quarterly newsletter

2 Social Media

Muliple Social Media posts were also circulated over time via Facebook, Instagram and X/Twitter.



[Instagram]

Facebook – Spring Quarterly circulated with Project Updates

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

https://www.facebook.com/share/r/19hgTkWYZK/

Field walk/s and Project/s wrap up post

https://www.facebook.com/share/r/14m3xdUjQK/

Recent Events: Field Walk Season

Narembeen Field Walk 13.09.24

To kick off a week of field days in September, the Corrigin Farm Improvement Group (CFIG) team travelled to Narembeen on Friday, September 13, 2024.

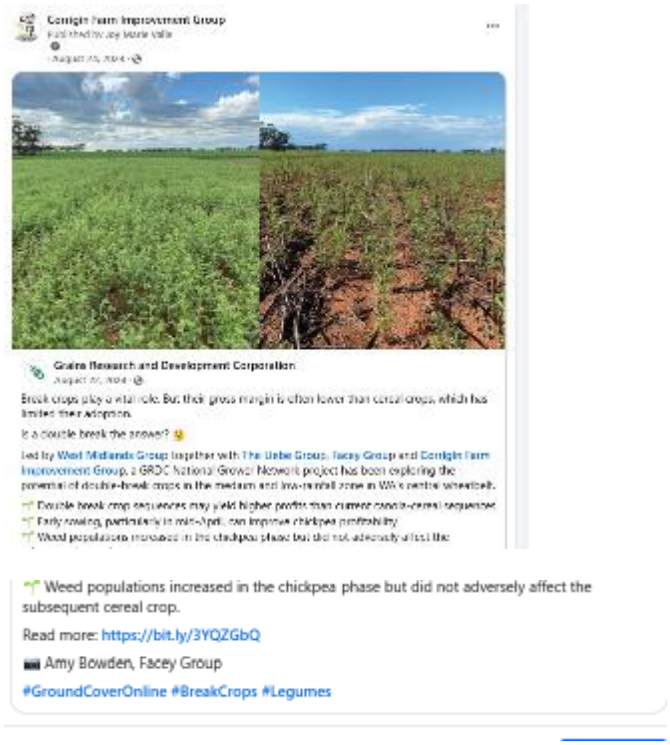
The half day event was a small but mighty group of keen Narembeen producers and agricultural industry representatives to chat about the season, any challenges they're facing and also the latest updates on local trials and relevant projects. After a bite of lunch we showed straight down to the bones of skeleton weed challenges, while looking at an exciting new tool to help fight it using biocontrol methods.

The discussion was led by Department of Primary Industries and Regional Development (DPIRD) project officer Kate Denchen, who showed the group the impact of the skeleton weed gall midge (Cystodiplosis sclerochaeti) is having on skeleton weed and the exciting results that are emerging. She was very keen to get in touch with any Wheatbelt farmers noticing and struggling with Skeleton Weed in the area, as she would like to add the Gall Midge to more sites, so get in contact with CFIG and we can connect you with Kate.

Lecanik agronomist Jack Randell spoke about establishing large scale trials and extended time frames, and said Lecanik currently have six sites established in the central eastern Wheatbelt region, including a site at Mr Walker farmer Mitch Mollin's property. Jack spoke about the Mollin's chem fallow trial and said the brown-out had the highest water retention rate and looked to be the way to go in that area, but they are trialling increasing K and P rates to see if there's any benefit, while also adjusting seeding rates from 50kg up to 75kg. The group visited the Mollin chem fallow trial site towards the end of our field walk, while also had a look at a LimeFarm trial and discussed various management strategies of Mollin's.

Back at our first site, where CFIG's RoleWise, Time of Sowing and Grain Legume project and trial plots are located at Dylan Cole's Narembeen property, Grower Group Alliance (GGA) project manager Dr Daniel Kidd spoke about each of those three projects.

Figure 6 Field Walk Summary in Newsletter



Corrigin Farm Improvement Group

Grains Research and Development Corporation

Break crops play a vital role. But their gross margin is often lower than cereal crops, which has limited their adoption.

Is a double break the answer?

Led by West Midlands Group together with The Ueber Group, Facey Group and Corrigin Farm Improvement Group, a GRDC National Grower Network project has been exploring the potential of double-break crops in the medium and low-rainfall zone in WA's central wheatbelt.

- Double break crop sequences may yield higher profit than current canola-cereal sequences
- Early sowing, particularly in mid-April, can improve chickpea profitability
- Weed populations increased in the chickpea phase but did not adversely affect the subsequent cereal crop.

Read more: https://bit.ly/3YQZGbQ

📷 Amy Bowden, Facey Group

#GroundCoverOnline #BreakCrops #Legumes

https://www.facebook.com/share/p/1677PfSj4c/

PHOTOS

Figure 7 Attendees listening to project update at beginning of Spring Field Day

Figure 8 Attendees at the Grain Legume Small Plot Trial

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Figure 9 CFIG Grain Legume Small Plot Trial Site

Figure 10 Daniel Kidd and Connor Baker with attendees at field walk.

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.

Albus lupin, lentil, chickpea, field pea, vetch and faba bean variety experiments – Wagga Wagga 2021

Evaluation of pulses and other seed legumes for crop rotations in Western Australia

Legume Logic, Global Vision Local Focus

Evaluation of pulses and other seed legumes for crop rotations in Western Australia

Monitoring every crop sequence across Western Austraia Low Rainfall Zone