NSW Pulse Agronomy Development and Extension Project

2021 summary of field trial results

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Acknowledgements

Project management

Rohan Brill, Brill Ag

Project investment

Grains Research and Development Corporation: project BRA2105-001RTX *Development and extension to close the economic yield gap and maximise farming systems benefits from grain legume production in New South Wales*

Contributors and trial management

Parkes and Canowindra: Maurie Street and Ben O'Brien, **Grain Orana Alliance** maurie.street@grainorana.com.au

Caragabal and Ganmain: Rohan Brill, **Brill Ag** rohan@brillag.com.au

Buruja: Tom Price and Ben Morris – **FAR Australia** tom.price@faraustralia.com.au

Barellan: Barry Haskins and Rachael Whitworth – **Ag Grow Agronomy and Research** rachael@aggrowagronomy.com.au

Gol Gol: Michael Moodie, **Frontier Farming Systems** michael@frontierfarming.com.au

Site hosts

Parkes: Nathan Border, Border Farming

Canowindra: Rob Atkinson, Viridis Ag

Caragabal: Daybreak Farming and Kirrily Condon (Grassroots Agronomy) for assistance with site selection.

Ganmain: The Brill family

Buruja: Dennis Tomlinson

Barellan: Jeff Savage "Wanda Downs"

Gol Gol: Ian, Daniel, James and Mickey Linklater and their families, Trentham Cliffs Station, Gol Gol.

Images

Cover: Caragabal species screen trial, 15 September 2021.

Other images: supplied by contributors.

Contents

Introduction

The project aims to close the economic yield gap and maximise farming system benefits of pulses in southern NSW. Sites were selected based on the following criteria:

- Currently a low percentage of pulses in the farming system, but with potential (and often the need) to increase pulse production.
- Local challenges limiting pulse production (both real and perceived) e.g. soil acidity, soil sodicity, climatic conditions and pulse crop adaptibility.
- Trials in regions/environments with lower research presence historically.

Figure 1: *Trial locations were selected by local collaborators to represent the range of environments and soil types and improve pulse production across southern and central NSW.*

Parkes and Canowindra

Parkes site attributes

2021

Soil chemical characteristics

Sampled 15 April

Characteristic	Unit	Soil depth (cm)			
		0–10	10–30	30–60	60–90
pH ($CaCl_2$)		5.7	6.4	8	8.3
Organic Carbon	%	1.4	0.9		
Phosphorus (Colwell)	mg/kg	48	16		
Potassium (Amm-acet.)	cmol(+)/kg	1.2	0.58		
Nitrate N	mg/kg	12	6.3	8.2	9.6
Ammonium N	mg/kg	2.6	1.4	1.5	1.1
Conductivity	dS/m	0.08	0.07	0.27	0.4
Cation Exchange Capacity	meq/100g	20.3	24.3		
Exchangeable calcium	%	54	52		
Exchangeable magnesium	%	39	42		
Exchangeable potassium	%	5.7	2.4		
Exchangeable sodium	%	1.4	3.2		
Exchangeable aluminium	%	<1.0	<1.0		

Crop sequence and key management dates

Crop sequence	
Year	Crop
2020	Wheat
2019	Wheat
2018	Canola

Site management		
Activity	Date	Comments
Sowing	13 May	Faba beans, lupins, vetch
	31 May	Lentils, chickpeas
Harvest	14 December	Faba beans, lupins, vetch, lentils, chickpeas

Seasonal conditions

Parkes temperature and rainfall

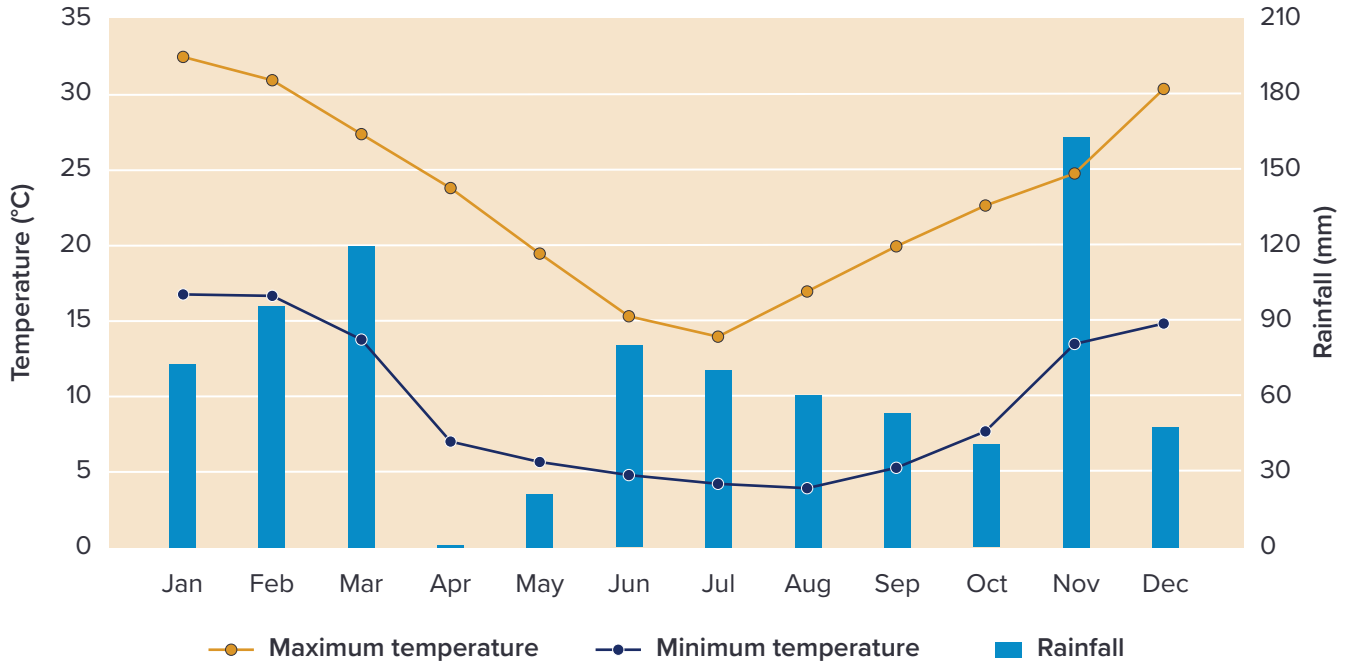


Figure 2: *Rainfall and temperature data for Parkes in 2021.*

Canowindra site attributes

2021

Soil chemical characteristics

Sampled April

Characteristic	Unit	Soil depth (cm)					
		0–5	5–10	10–30	30–60	60–90	190–120
pH ($CaCl_2$)		4.7	4.9	4.8			
Organic Carbon	%	2.33	1.66	0.40			
Phosphorus (Colwell)	mg/kg	48	20	13			
Potassium (Colwell)	mg/kg	735	628	0.8			
Nitrate N	mg/kg	17	12	14	10	9.5	7.3
Ammonium N	mg/kg			0.7	0.7	0.8	0.6
Conductivity (1:5 water)	dS/m	0.077	0.056	0.040			
Cation Exchange Capacity	meq/100g	11.29	11.12	5.6			
Exchangeable calcium	%	69	70	68			
Exchangeable magnesium	%	11	12	14			
Exchangeable potassium	%	17	13	14			
Exchangeable sodium	%	1.00	<1.00	<1.00			
Exchangeable aluminium	%	2	3	2.8			

Crop sequence and key management dates

Crop sequence	
Year	Crop
2020	Wheat
2019	Canola
2018	Pasture
2017	Pasture

Site management		
Activity	Date	Comments
Sowing	3 May	Faba beans, lupins, vetch
	20 May	Lentils, chickpeas
Harvest	15 December	Faba beans, lupins, lentils
	17 January	Chickpeas

Seasonal conditions

Canowindra temperature and rainfall

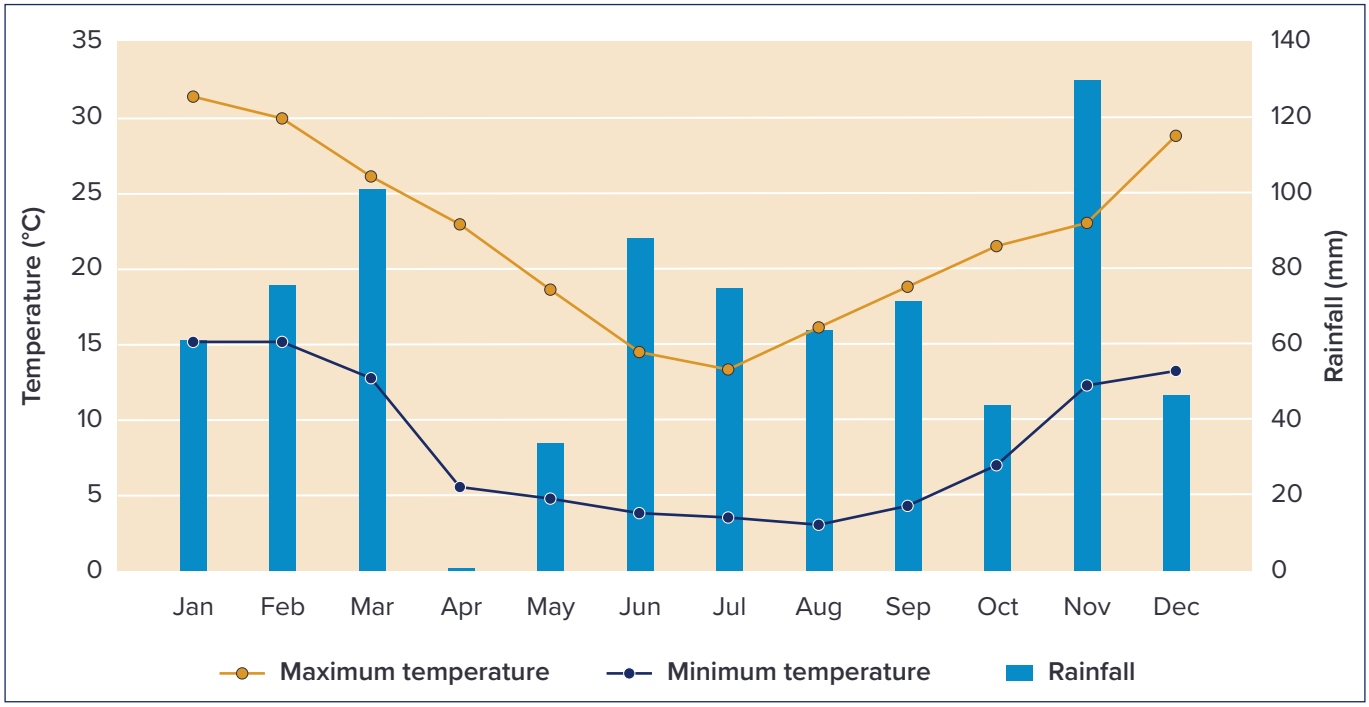


Figure 3: *Rainfall and temperature data for Canowindra in 2021.*

Pulse species and variety comparison

Parkes and Canowindra 2021

Key findings

- Faba beans had the highest grain yield (average 5.7 t/ha Canowindra and 5.8 t/ha Parkes) and produced very high biomass (average 14.9 t/ha Canowindra and 13.6 t/ha Parkes) at both sites. The high biomass indicates a high amount of nitrogen fixed (N-fix samples currently being processed), but the beans also had very high removal in the grain with an average removal of 229 kg N/ha at Canowindra and 262 kg N/ha at Parkes.
- Faba beans out-yielded both canola and wheat at Canowindra and Parkes, even with high N input.
- Murringo$^{\phi}$ (albus) and PBA Bateman$^{\phi}$ (narrow-leaf) lupins produced very high biomass at Canowindra (17.6 and 15.6 t/ha respectively), but grain yield was lower than faba beans. Biomass of lupins was lower at the Parkes site (3.0 and 7.9 t/ha for Murringo$^{\phi}$ and PBA Bateman$^{\phi}$ respectively) which had intermittent waterlogging. Grain yield followed a similar trend with high yield for Murringo$^{\phi}$ (4.3 t/ha) and PBA Bateman$^{\phi}$ (3.4 t/ha) at Canowindra but low yield for Murringo$^{\phi}$ (0.8 t/ha) and moderate yield for PBA Bateman$^{\phi}$ (2.6 t/ha) at Parkes.
- The dry matter production from vetch was relatively low at both sites but vetch was cut at an earlier growth stage (before podding) to simulate hay cut timing.
- CBA Captain$^{\phi}$ chickpeas had relatively low biomass compared to faba beans at both sites, with moderate grain yield (2.2 and 2.6 t/ha at Canowindra and Parkes respectively). CBA Captain$^{\phi}$ chickpeas yielded more than lentils at both sites. Lentils (like Murringo$^{\phi}$ albus lupins) suffered from waterlogging at Parkes and had low biomass and yield.
- Lupins had the highest seed N content, removing 90% more N than chickpeas (lowest seed N content) per tonne of grain produced.
- An assessment of total nitrogen derived from fixation is being completed on the biomass samples to determine a nitrogen balance of each species at these sites and other sites in the project.

Trial Details

Table 1: *Trial management and fungicide treatments applied at Parkes and Canowindra in 2021.*

Management	Details	Parkes	Canowindra
Sowing Date	Canola, faba beans, lupins, vetch	31 May	3 May
	Wheat, chickpeas, lentils		20 May
Harvest Date	Faba beans, canola	14 December	23/11/2021
	Wheat, chickpeas, lupins, lentils	23 December	
	Wheat, narrow-leaf lupins, lentils		12 December
	Chickpeas, broadleaf lupins		17 January 2022
Starter Fertiliser	MAP	75 kg/ha	30 kg/ha

Results

Biomass and grain yield

Table 2: *Peak biomass* and grain yield of two varieties of five legume species plus one variety of canola and wheat (both with a high and low N rate)† at Canowindra and Parkes in 2021.*

Species	Variety	Canowindra		Parkes	
		Peak biomass (t/ha)	Grain yield (t/ha)	Peak biomass (t/ha)	Grain yield (t/ha)
Canola (High N)	HyTTec Trophy	14.8	4.0	9.3	2.4
Canola (Low N)	HyTTec Trophy	12.5	3.8	8.2	2.1
Chickpea	CBA Captain	7.0	2.2	9.0	2.6
	PBA Hattrick	4.0	0.8	8.2	2.3
Faba bean	PBA Nasma	14.8	5.5	12.1	5.3
	PBA Samira	15.0	5.8	15.1	6.3
Lentil	PBA Hallmark XT	6.7	1.4	3.9	0.7
	PBA Kelpie/ GIA Leader	6.8	1.6	2.4	0.2
Lupin	PBA Bateman	15.6	3.4	7.9	2.6
	Murringo	17.6	4.3	3.0	0.8
Vetch (hay)	Studenica	5.5	–	4.7	–
Wheat (High N)	LRPB Mustang/ LRPB Flanker	13.7	4.3	9.1	3.8
Wheat (Low N)	LRPB Mustang/ LRPB Flanker	12.1	3.9	7.8	3.8
l.s.d. (P = 0.05)		2.8	0.6	3.4	1.0

* Peak biomass sampling targeted at early–mid pod fill for each species. Vetch was cut before podding in line with commercial practice for hay production.

† High N rate = 120 kg N/ha (50 kg/ha urea 20 July + 211 kg/ha urea 3 September). Low N rate = 40 kg N/ha (50 kg/ha urea 20 July + 36 kg/ha urea 3 September).

Figure 4: *Species screen trial, generally growing well with no soil type restrictions at Canowindra in 2021.*

Seed nitrogen concentration and N removal

Table 3: *Grain nitrogen (N) concentration, grain yield and calculated Total N removal of two varieties of four pulse species at Canowindra and Parkes in 2021.*

Location		Canowindra			Parkes		
Species	Variety	Grain N (%)	Grain yield (t/ha)	Total N removal (kg/ha)	Grain N (%)	Grain yield (t/ha)	Total N removal (kg/ha)
Chickpea	CBA Captain	3.4	2.2	74.2	3.4	2.6	88.9
	PBA Hattrick	3.5	0.8	28.1	3.4	2.3	79.3
Faba bean	PBA Nasma	4.1	5.5	228.9	4.5	5.3	242.4
	PBA Samira	4.0	5.8	230.3	4.5	6.3	282.7
Lentil	PBA Hallmark XT	4.2	1.4	58.7	4.0	0.7	29.2
	GIA Leader/ PBA Kelpie XT	4.3	1.6	69.1	4.1	0.2	10.5
Lupin	PBA Bateman	5.3	3.4	179.5	5.1	2.6	132.4
	Murringo	6.1	4.3	262.6	5.9	0.8	49.0
l.s.d. (P<0.05)		0.19	0.6	21.3	0.2	1.0	41.3

Figure 5: *Species screen trial. Murringo$^{\Phi}$ lupins (front left), PBA Bateman$^{\Phi}$ lupins (front right). Faba beans rear centre with chickpeas to the left and wheat to the right.*

Chickpea disease management

Parkes and Canowindra 2021

Key findings

- PBA Drummond$^{\Phi}$ generally had more Ascochyta blight infection than CBA Captain$^{\Phi}$.
- Fungicide reduced Ascochyta blight infection in both varieties.
- At Canowindra on 17 September Ascochyta blight infection was rated as 6.1 in untreated PBA Drummond$^{\Phi}$ (1 = no disease, 10 = disease across whole plot and all plants dying) and 2.5 in untreated CBA Captain$^{\Phi}$.
- Fungicide reduced Ascochyta blight infection in CBA Captain$^{\Phi}$ (rated moderately susceptible [MS] to Ascochyta blight) and PBA Drummond$^{\Phi}$ (rated susceptible [S] to Ascochyta blight) at both Canowindra and Parkes.
- Where fungicide applications were *Delayed* until after the crop had visible signs of Ascochyta blight, yield was lower than the *Complete* fungicide treatment for PBA Drummond$^{\Phi}$ but the same as *Complete* fungicide treatment for CBA Captain$^{\Phi}$ (at both sites).
- The average yield was 1.78 t/ha at Canowindra and 1.49 t/ha at Parkes
- At Parkes the yield of CBA Captain$^{\Phi}$ was 0.7 t/ha higher in the *Complete* fungicide treatment compared to the *Nil*. PBA Drummond$^{\Phi}$ yield increased by 2 t/ha for the same comparison.
- At Canowindra, CBA Captain$^{\Phi}$ yield increased by 1.5 t/ha and PBA Drummond$^{\Phi}$ by 1.3 t/ha from *Nil* to *Complete* fungicide. However, the yield of the CBA Captain$^{\Phi}$ was still more than double the yield of PBA Drummond$^{\Phi}$ in a high disease pressure environment.
- At Canowindra, yield of CBA Captain$^{\Phi}$ with *Nil* fungicide was either equal to or better than PBA Drummond$^{\Phi}$ with fungicide applied. At Parkes, yield of CBA Captain with nil fungicide was higher than both the Budget and Delayed treatment, but lower than the Complete treatment of PBA Drummond$^{\Phi}$.
- These trials show that even a subtle improvement in varietal resistance from susceptible (PBA Drummond$^{\Phi}$) to moderately susceptible (CBA Captain$^{\Phi}$) can take a lot of pressure off fungicide programs in environments and seasons conducive to disease.

Trial details

Table 4: *Trial management and fungicide treatments applied at Parkes and Canowindra in 2021.*

Management	Parkes			Canowindra		
Sowing date	31 May			20 May		
Harvest date	23 December			17 January 2022		
Starter fertiliser	75 kg/ha MAP					
Fungicide strategy	Parkes			Canowindra		
	Date applied	Product	Rate (per ha)	Date applied	Product	Rate (per ha)
Nil		Nil			Nil	
Budget	20 July	Mancozeb 750	1.7 kg	16 June	Mancozeb 750	1.7 kg
	24 September	Chlorothalonil	1.0 L	17 September	Chlorothalonil	0.5 L
	2 November	Chlorothalonil	0.5 L	27 September	Chlorothalonil	1.0 L
	19 November	Mancozeb 750	1.7 kg	2 November	Chlorothalonil	0.5 L
				19 November	Mancozeb 750	1.7 kg
Delayed	24 September	Aviator® Xpro®	600 mL	17 September	Aviator® Xpro®	600 mL
	–	–	–	27 September	Veritas®	1.0 L
	6 October	Veritas®	1.0 L	6 October	Chlorothalonil	1.0 L
	2 November	Chlorothalonil	1.0 L	2 November	Chlorothalonil	1.0 L
	19 November	Veritas®	1.0 L	19 November	Veritas®	1.0 L
Complete	20 July	Mancozeb 750	1.7 kg	16/06/2021	Mancozeb 750	1.7 kg
	23 August	Chlorothalonil	0.5 L	5 August	Chlorothalonil	0.5 L
	16 September	Chlorothalonil	0.5 L	17 September	Aviator® Xpro®	600 mL
	27 September	Chlorothalonil	0.5 L	27 September	Veritas®	1.0 L
	6 October	Aviator® Xpro®	600 mL	6 October	Chlorothalonil	1.0 L
	2 November	Veritas®	1.0 L	2 November	Chlorothalonil	1.0 L
	19 November	Veritas®	1.0 L	19 November	Veritas®	1.0 L

* Mancozeb 750 = 750 g/kg mancozeb; Aviator® Xpro® = 75 g/L bixafen and 150 g/L prothioconazole; Carbendazim = 500 g/L carbendazim; Chlorothalonil = 720 g/L chlorothalonil; Veritas® = . 120 g/L azoxystrobin + 200 g/L tebuconazole

Results

Grain yield

Table 5: *Grain yield of chickpeas under four fungicide strategies at Parkes and Canowindra in 2021.*

Fungicide strategy	Grain yield (t/ha)					
	Canowindra			Parkes		
	CBA Captain	PBA Drummond	Fungicide Mean	CBA Captain	PBA Drummond	Mean (Fungicide)
Nil	1.6	0.1	***0.8***	1.5	0.2	***0.9***
Budget	2.9	1.0	***1.9***	1.8	0.4	***1.1***
Delayed	3.3	0.9	***2.1***	2.4	1.1	***1.8***
Complete	3.1	1.4	***2.3***	2.2	2.2	***2.2***
Mean (Variety)	***2.7***	***0.9***		***2.0***	***1.0***	
l.s.d. (*P* = 0.05) Variety	0.5 t/ha			0.6 t/ha		
l.s.d. (*P* = 0.05) Fungicide	0.3 t/ha			0.4 t/ha		
l.s.d. (*P* = 0.05) Variety × Fungicide	Not significant			Not significant		

Faba bean disease management

Parkes 2021

Key findings

- Grain yield of the two faba bean varieties PBA Nasma(ф) and PBA Samira(ф) was very high, with an average yield of 6.2 t/ha.
- Chocolate spot disease severity was low across the trial.
- Fungicide application reduced chocolate spot severity in both varieties.
- The low level of chocolate spot infection did not reduce yield.
- PBA Nasma(ф) had slightly more chocolate spot infection than PBA Samira(ф).
- PBA Samira(ф) (6.4 t/ha) yielded slightly more than PBA Nasma(ф) (6.1 t/ha).

Trial Details

Table 6: *Trial management and fungicide treatments applied to faba beans at Parkes in 2021.*

Management			
Sowing Date	13 May		
Harvest Date	14 December		
Starter Fertiliser	30 kg/ha MAP		
Varieties	PBA Nasma(ф) and PBA Samira(ф)		
Treatment	**Date applied**	**Fungicide product***	**Fungicide rate (per ha)**
Nil		Nil	
Budget	23 August	Mancozeb 750	1.7 kg
Delayed	16 September	Aviator® Xpro®	0.6 L
Complete	16 June	Mancozeb 750	1.7 kg
	23 August	Aviator® Xpro®	0.6 L
	16 September	Chlorothaloni + Carbendazim	2.3 L + 0.5 L
	27 September	Veritas®	1.0 L
	6 October	Chlorothalonil	2.3 L

* Mancozeb 750 = 750 g/kg mancozeb; Aviator® Xpro® = 75 g/L bixafen and 150 g/L prothioconazole; Carbendazim = 500 g/L carbendazim; Chlorothalonil = 720 g/L chlorothalonil; Veritas® = . 120 g/L azoxystrobin + 200 g/L tebuconazole

Results

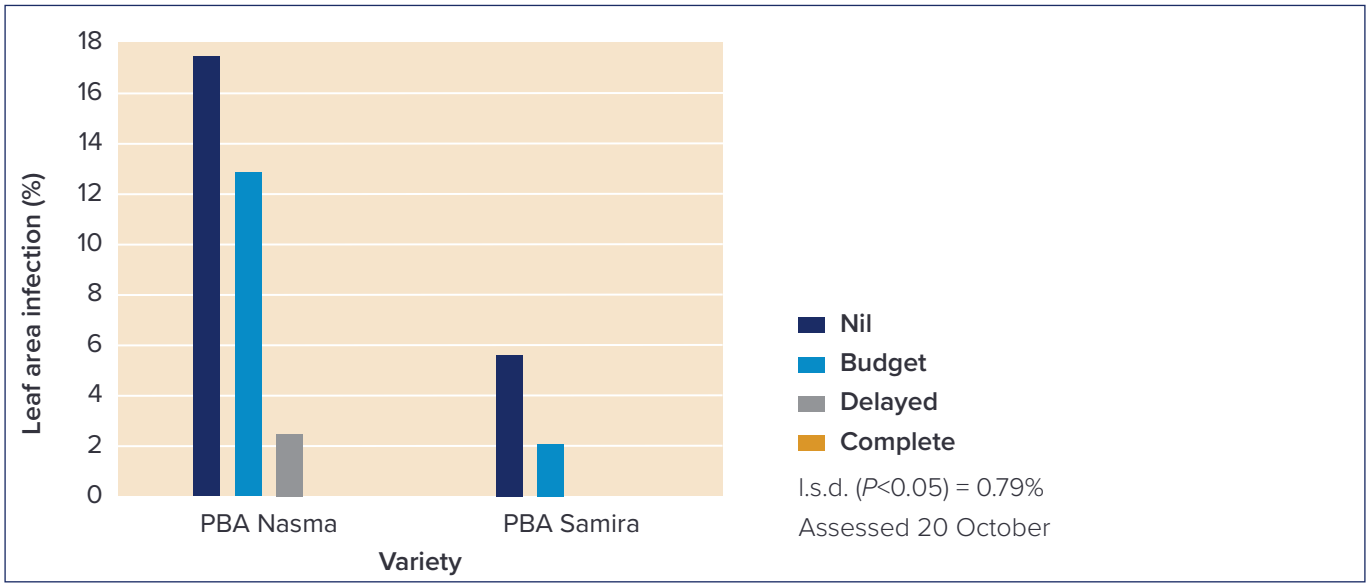


Figure 6: *Effect of four fungicide strategies on chocolate spot leaf area infection at Parkes in 2021.*

Table 7: *Grain yield of faba beans under four fungicide strategies at Parkes in 2021.*

Fungicide strategy	Yield (t/ha)		
	PBA Nasma	PBA Samira	Mean (Fungicide)
Nil	6.0	6.6	*6.3*
Budget	6.2	6.5	*6.3*
Delayed	6.2	6.3	*6.3*
Complete	5.9	6.3	*6.1*
Mean (Variety)	*6.1*	*6.4*	
l.s.d. (*P*<0.05) Variety	0.19		
l.s.d. (*P*<0.05) Fungicide	n.s.		
l.s.d. (*P*<0.05) Variety × Fungicide	n.s.		

Caragabal site attributes
2021

Soil chemical characteristics

Sampled 15 April

Characteristic	Unit	Depth (cm)	
		0–10	10–20
Ammonium nitrogen	mg/kg	7	5
Nitrate nitrogen	mg/kg	2	3
Phosphorus Colwell	mg/kg	51	12
Potassium Colwell	mg/kg	383	225
Sulfur	mg/kg	3.1	5.7
Organic Carbon	%	0.96	0.50
Conductivity	dS/m	0.038	0.045
pH ($CaCl_2$)		5.0	4.9
DTPA Copper	mg/kg	0.73	0.76
DTPA Iron	mg/kg	44.30	23.90
DTPA Manganese	mg/kg	19.19	13.62
DTPA Zinc	mg/kg	0.79	0.19
Exchangeable aluminium	meq/100g	0.080	0.110
Exchangeable calcium	meq/100g	4.53	3.71
Exchangeable magnesium	meq/100g	0.54	0.82
Exchangeable potassium	meq/100g	0.90	0.46
Exchangeable sodium	meq/100g	0.02	0.07
Boron (Hot $CaCl_2$)	mg/kg	0.60	0.54

Crop sequence and key management dates

Crop sequence		
Year	Crop	Cultivar
2020	Wheat	Beckom[ф]
2019	Canola	Pioneer® 43Y92
2018	Wheat	Scepter[ф]

Site management		
Activity	Date	Comments
Sowing	29 April	Faba beans, vetch, lupins
	18 May	Lentils, field peas, chickpeas
Harvest	4 December	Faba beans, vetch, lentils, narrow-leaf lupins, field peas
	3 January 2022	Chickpea, albus lupins

Seasonal conditions

Caragabal temperature and rainfall

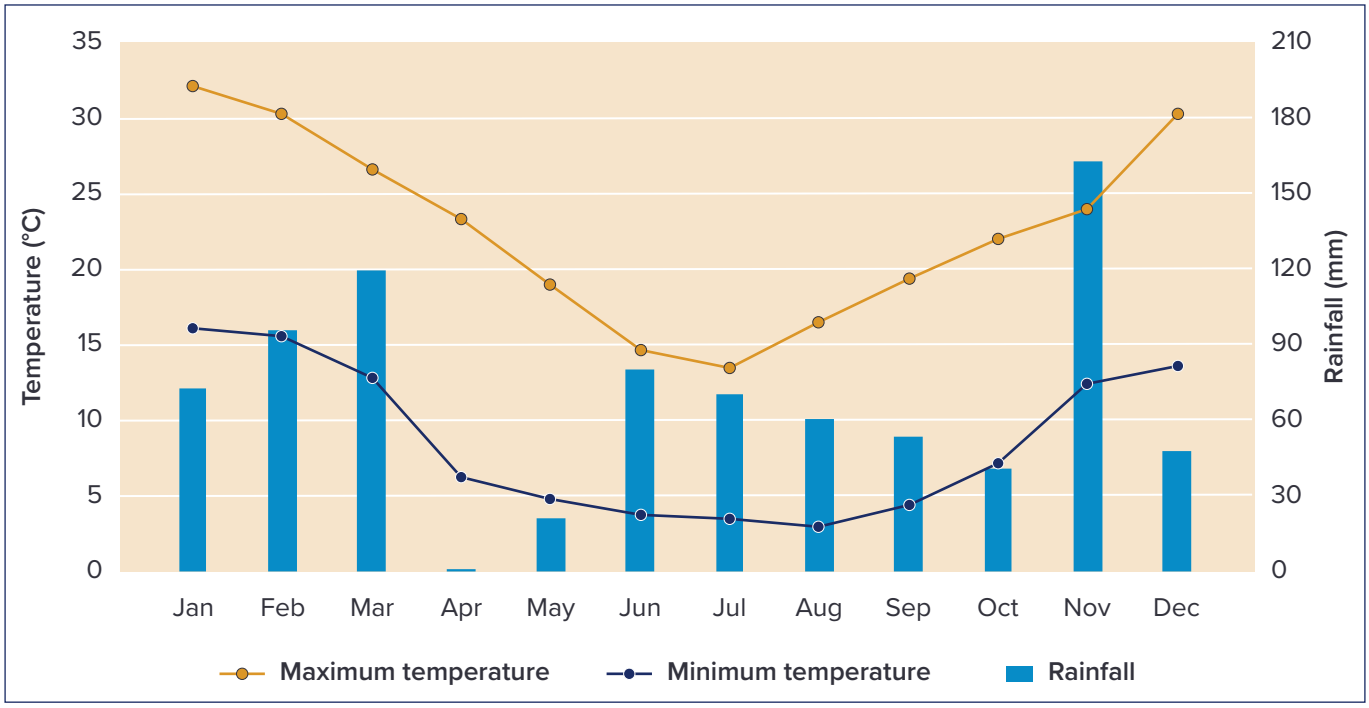


Figure 7: *Rainfall and temperature data for Caragabal in 2021.*

Figure 8: *Species screen trial at Caragabal on 21 June 2021.*

Ganmain site attributes

2021

Soil chemical characteristics

Sampled 15 April

Characteristic	Unit	Soil depth (cm)			
		0–10	10–20	20–30	30–60
pH ($CaCl_2$)		5.3	5.6	5.5	6.2
Organic Carbon	%	1.09	0.61	0.45	0.31
Phosphorus (Colwell)	mg/kg	76	24	8	4
Potassium (Colwell)	mg/kg	453	312	235	374
Nitrate N	mg/kg	9	6	1	4
Ammonium N	mg/kg	7	4	5	5
Conductivity	dS/m	0.077	0.058	0.053	0.107
Cation Exchange Capacity	meq/100g	8.04	9.25	8.86	19.58
Exchangeable calcium	%	70.0	53.6	44.2	31.4
Exchangeable magnesium	%	13.9	31.2	39.1	48.1
Exchangeable potassium	%	13.3	7.9	6.5	5.0
Exchangeable sodium	%	2.1	5.8	9.1	14.9
Exchangeable aluminium	%	0.6	1.4	1.0	0.6

Crop sequence and key management dates

Crop sequence		
Year	Crop	Cultivar
2020	Wheat	Beckom$^{\phi}$
2019	Canola	Pioneer® 43Y92 CL
2018	Lupins	Mandelup$^{\phi}$
2017	Wheat	Corack$^{\phi}$
2016	Barley	La Trobe$^{\phi}$

Site management		
Activity	Date	Comments
Sowing	28 April	Faba beans, vetch, lupins
	18 May	Lentils, field peas, chickpeas
Harvest	3 December	Faba beans, vetch, lentils, field peas
Note: Chickpea plots were wiped out by hail on 18 December		

Seasonal conditions

Ganmain temperature and rainfall

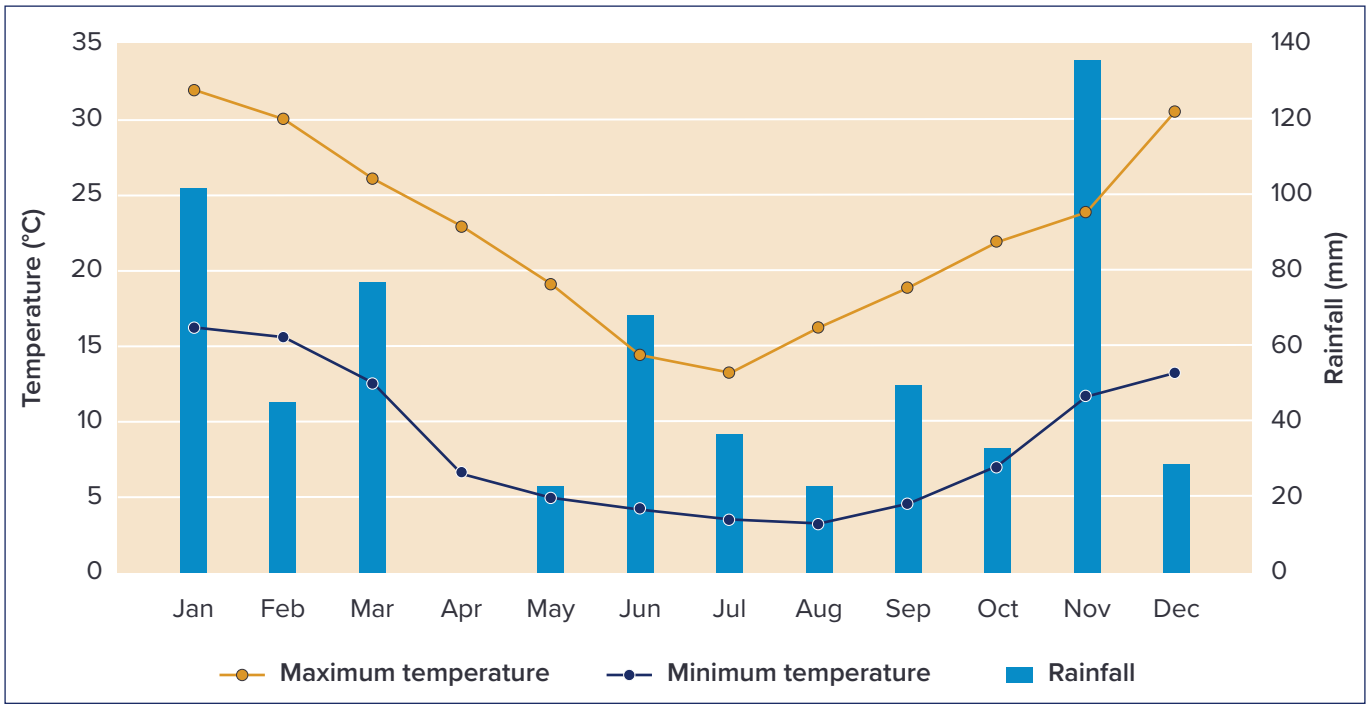


Figure 9: *Rainfall and temperature data for Ganmain in 2021.*

Pulse species and variety comparison

Ganmain and Caragabal 2021

Key findings

- Four variety screening trials were sown at each site; one in late April, an *Early screen* including faba beans, vetch and lupins; three further trials were sown in mid-May – *Chickpea screen*, *Field pea screen* and *Lentil screen*.
- In the Early screen, PBA Samira$^{\Phi}$ grew the most biomass (17.4 and 12.0 t/ha) and had the highest grain yield (5.7 and 5.2 t/ha) at both Caragabal and Ganmain, respectively.
- There were large differences in seed size (grain weight) for faba beans at both sites which is important from a marketing perspective (larger grains generally more desirable) and for use as seed when calculating sowing rate.
- Faba beans yielded more than double the lupin varieties at Caragabal, primarily due to their ability to tolerate intermittent waterlogging.
- At both Ganmain and Caragabal the desi chickpea varieties CBA Captain$^{\Phi}$, PBA Drummond$^{\Phi}$ and PBA Slasher$^{\Phi}$ grew more biomass than the kabuli variety PBA Royal$^{\Phi}$. The desi varieties also had higher yield than the kabuli variety PBA Royal$^{\Phi}$ at Caragabal. Grain size of the kabuli PBA Royal$^{\Phi}$ was approximately 70% larger than the desi varieties.
- There was no difference in grain yield between the four lentil varieties at each location (Caragabal average 1.7 t/ha, Ganmain average 2.0 t/ha). Intermittent waterlogging at Caragabal likely reduced grain yield compared to Ganmain. PBA Kelpie$^{\Phi}$ produced larger seed than the three other varieties PBA Hallmark$^{\Phi}$, PBA Highland$^{\Phi}$ and GIA Leader$^{\Phi}$.
- In the field pea trial, PBA Butler$^{\Phi}$ and PBA Taylor$^{\Phi}$ (both 3.4 t/ha) yielded more than PBA Wharton$^{\Phi}$ (2.9 t/ha) and PBA Percy$^{\Phi}$ (2.6 t/ha) at Caragabal. There was no yield difference in the field pea trial at Ganmain (average 2.9 t/ha).
- Grain N concentration was generally highest for vetch and lupins; intermediate for faba beans, field peas and lentils and lowest for chickpeas. Calculated N removal (yield × grain N %) was highest for the high yielding faba beans, averaging 235 kg N/ha removed.
- Biomass data is being processed to determine N-fix of each species which will be used to calculate the N balance for each pulse species.

Trial details

Table 8: *Trial management in four variety screen trials at Ganmain and Caragabal in 2021.*

Management	Ganmain	Caragabal
Sowing Date	28 April Early Screen (faba bean, lupins, vetch)	29 April Early Screen (faba bean, lupins, fetch)
	19 May Chickpea screen, field pea screen, lentil screen	19 May Chickpea screen, field pea screen, lentil screen
Starter Fertiliser	170 kg/ha single super	

Species	Target plant population (plants/m^2)	Variety
Chickpea	40	CBA Captain$^{\Phi}$, PBA Drummond$^{\Phi}$, PBA Royal$^{\Phi}$, PBA Slasher$^{\Phi}$
Faba Bean	25	PBA Bendoc$^{\Phi}$, PBA Marne$^{\Phi}$, PBA Nasma$^{\Phi}$, PBA Samira$^{\Phi}$
Field Pea	40	PBA Butler$^{\Phi}$, PBA Percy$^{\Phi}$, PBA Taylor$^{\Phi}$, PBA Wharton$^{\Phi}$
Lentils	120	GIA Leader$^{\Phi}$, PBA Hallmark$^{\Phi}$, PBA Highland$^{\Phi}$, PBA Kelpie$^{\Phi}$
Lupins	40	PBA Bateman$^{\Phi}$, Murringo$^{\Phi}$
Vetch	60	Timok$^{\Phi}$

Results

Early Screen

Table 9: *Peak biomass, grain yield and seed weight of faba beans, lupins and vetch in the Early screen trial at Ganmain and Caragabal in 2021.*

Location		Caragabal			Ganmain*		
Species	Variety	Peak biomass (t/ha)	Grain yield (t/ha)	100 seed weight (g)	Peak biomass (t/ha)	Grain yield (t/ha)	100 seed weight (g)
Faba bean	PBA Bendoc	9.7	4.8	58.3	8.1	4.7	52.9
	PBA Marne	10.2	5.1	63.4	7.7	4.0	58.1
	PBA Nasma	15.8	5.0	74.3	9.8	4.2	69.0
	PBA Samira	17.4	5.7	65.9	12.0	5.2	64.1
Lupin	PBA Bateman	9.7	2.1	16.8	*	*	*
	Murringo	*	2.3	34.1	*	*	*
Vetch	Timok	11.1	1.5	6.4	6.3	2.5	6.6
l.s.d. (P<0.05)		2.5	0.7	1.7	2.5	0.6	2.0

*Lupins were grazed through the season by hares at Ganmain therefore the results are not included.

Chickpea screen

Table 10: *Peak biomass, grain yield and seed weight of four chickpea varieties at Caragabal and Ganmain in 2021.*

Location	Caragabal			Ganmain*
Variety	Peak biomass (t/ha)	Grain yield (t/ha)	100 seed weight (g)	Peak biomass (t/ha)
CBA Captain	9.9	2.2	21.3	6.0
PBA Drummond	10.4	2.0	22.6	6.9
PBA Royal	7.2	1.1	34.4	5.4
PBA Slasher	9.2	1.9	20.0	6.9
l.s.d. (P = 0.05)	1.9	0.5	2.3	1.4

*Chickpea plots at Ganmain were destroyed by hail prior to harvest.

Field pea screen

Table 11: *Peak biomass (one cultivar only at Caragabal), grain yield and seed weight of four field pea varieties at Caragabal and Ganmain in 2021.*

Location	Caragabal			Ganmain		
Variety	Peak biomass (t/ha)	Grain yield (t/ha)	100 seed weight (g)	Peak biomass (t/ha)	Grain yield (t/ha)	100 seed weight (g)
PBA Butler	–	3.4	21.0	8.0	3.1	19.7
PBA Percy	–	2.6	22.8	7.0	2.8	22.1
PBA Taylor	7.2	3.4	20.0	8.4	3.1	19.0
PBA Wharton	–	2.9	20.3	8.3	2.7	18.0
l.s.d. (P = 0.05)		0.5	1.0	n.s.	n.s.	1.6

Lentil screen

Table 12: *Peak biomass (Ganmain only), grain yield and seed weight of four lentil varieties at Caragabal and Ganmain in 2021.*

Location	Caragabal			Ganmain		
Variety	Peak biomass (t/ha)	Grain yield (t/ha)	100 seed weight (g)	Peak biomass (t/ha)	Grain yield (t/ha)	100 seed weight (g)
GIA Leader	–	1.7	3.8	5.1	1.9	3.9
PBA Hallmark XT	–	1.7	3.6	5.5	2.1	3.8
PBA Highland XT	–	1.7	3.6	6.0	1.9	3.8
PBA Kelpie XT	–	1.5	4.3	5.3	2.0	4.5
l.s.d. (p=0.05)	–	n.s.	0.2	n.s.	n.s.	0.3

Nitrogen removal

Table 13: *Grain nitrogen concentration, grain yield and calculated total nitrogen removed from one variety of faba bean, vetch, field pea and lentil (Caragabal and Ganmain); lupin and chickpea (Caragabal only) in 2021.*

Location		Caragabal			Ganmain		
Species	Variety	Grain N concentration (%)	Grain yield (t/ha)	Total N removed (kg/ha)	Grain N concentration (%)	Grain yield (t/ha)	Total N removed (kg/ha)
Faba Bean	PBA Samira	4.50	5.7	257	4.12	5.2	214
Vetch	Timok	5.50	1.5	83	4.62	2.5	116
Field Pea	PBA Taylor	4.14	3.4	141	3.72	3.1	115
Lentil	PBA Hallmark	4.36	1.7	74	4.24	2.1	89
Lupin	PBA Bateman	5.55	2.1	117	–	–	–
Chickpea	CBA Captain	3.36	1.9	64	–	–	–

Faba bean plant density

Ganmain and Caragabal 2021

Key findings

- Increasing plant density from 10 to 40 plants/m^2 increased the lower pod height from 30 to 41 cm and the upper pod height from 70 to 85 cm (measured only at Ganmain).
- There was close to a 1 t/ha yield increase at Ganmain where plant density increased from 10 to 20 plants/m^2 (65 to 130 kg/ha seeding rate), with no further yield response to higher plant densities.
- There was no difference in grain yield with plant density ranging from 20 to 40 plants/m^2 at Caragabal.
- Grain size increased as plant population increased at Ganmain but there was no difference in grain size across the plant populations at Caragabal.

Trial Details

Table 14: *Trial management and treatments applied at Ganmain and Caragabal in 2021.*

Management		Ganmain	Caragabal
Sowing Date		28 April	29 April
Variety		PBA Samira$^{\Phi}$	
Starter Fertiliser		170 kg/ha single super (0% N, 8.8% P, 11% S)	
Treatment	**Sowing rate (kg/ha)**	**Established plant density (plants/m^2)**	
10 plants/m^2	65	13	11
20 plants/m^2	130	21	21
30 plants/m^2	195	29	27
40 plants/m^2	260	35	34

Results

Pod Depth

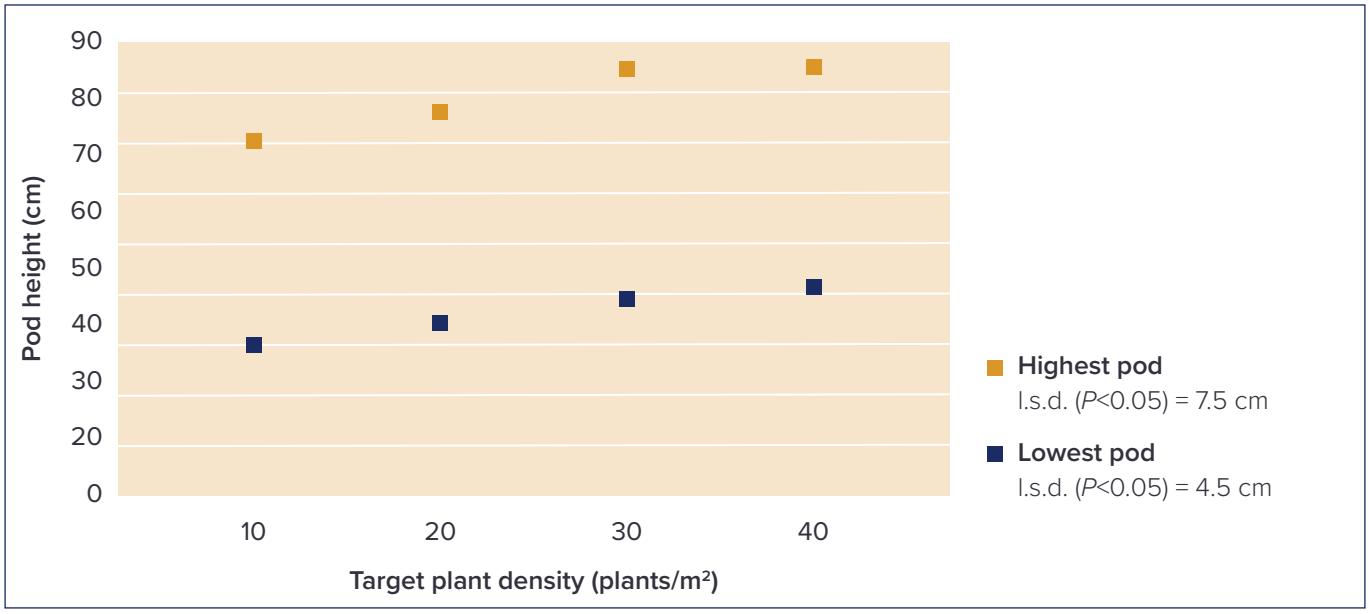


Figure 10: *Effect of seeding rate on faba bean (PBA Samira$^{(\phi)}$) pod depth at Ganmain in 2021.*

Grain yield

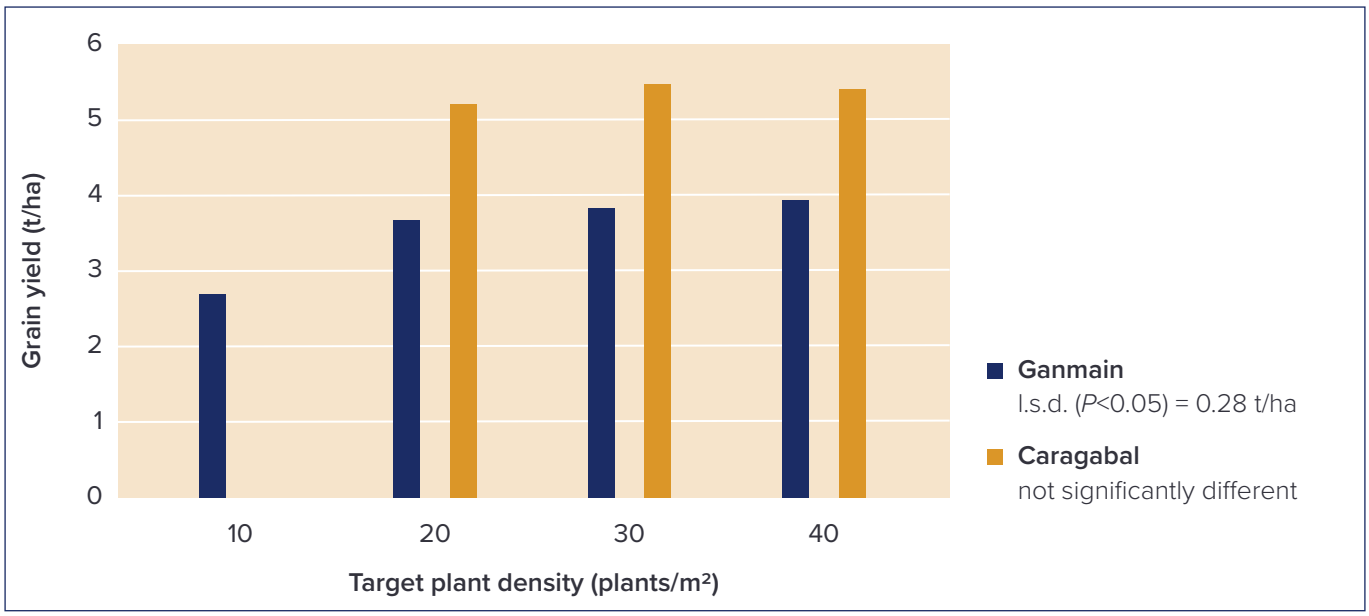


Figure 11: *Effect of plant population on grain yield of faba bean (PBA Samira$^{(\phi)}$) at Ganmain and Caragabal in 2021.*

Seed weight

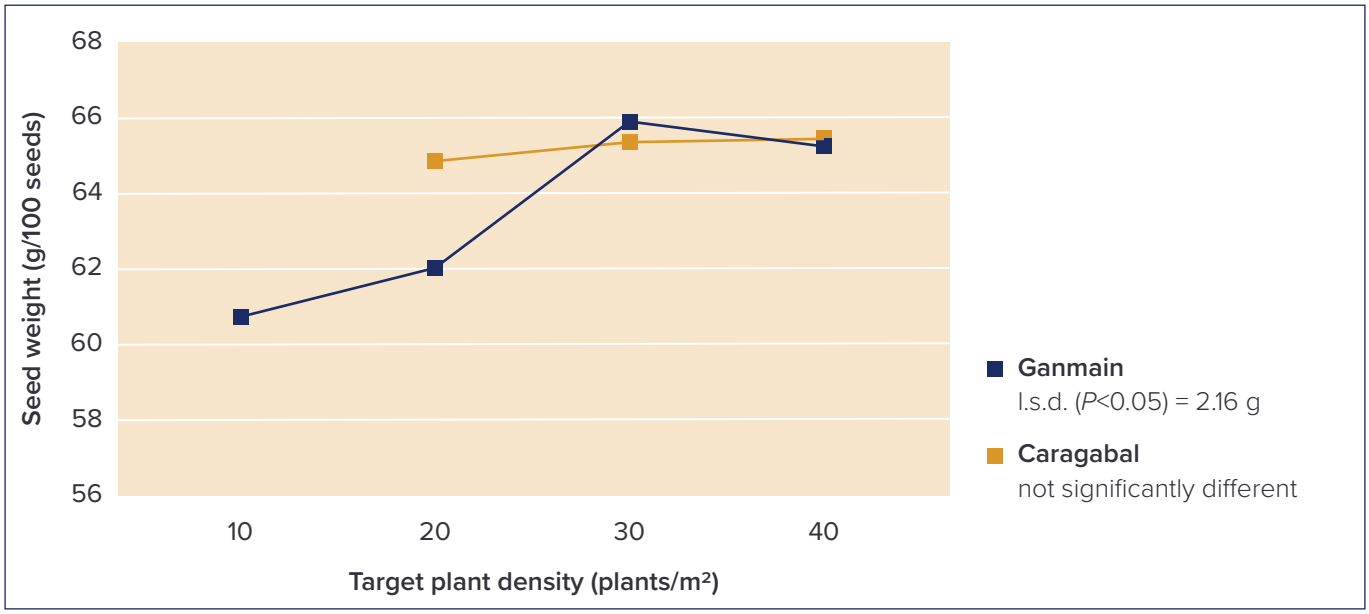


Figure 12: *Effect of plant population on harvested seed weight of faba bean (PBA Samira$^{(\phi)}$) at Ganmain and Caragabal in 2021.*

Faba bean phosphorus management

Ganmain 2021

Key findings

- Where phosphorus (P) was applied in-furrow with seed, increasing P fertiliser rate to 20 kg/ha (227 kg/ha single superphosphate) reduced plant establishment by ~12% compared to where no P was applied. P application in-furrow with seed did not affect establishment at rates up to 10 kg/ha.
- There was no effect of P application on establishment where it was broadcast in front of the seeder and incorporated by sowing (IBS).
- The application of 5 kg/ha P (57 kg/ha single superphosphate) increased yield by 0.3 t/ha compared to nil P, but there was no further yield increase with higher P rates.
- There was no difference in yield between the P application treatments, either incorporated by sowing (IBS) or placed in-furrow with seed.

Trial Details

Table 15: *Trial management and treatments applied at Ganmain in 2021.*

Management	
Sowing date	28 April
Soil phosphorus 0–10 cm (Colwell)	73 mg/kg
Soil pH ($CaCl_2$)	5.3
Row spacing	25 cm
Cultivar	PBA Samira(ϕ)
Treatements	
Phosphorus rate (kg P/ha)	0
	5 (57 kg/ha SSP)
	10 (114 kg/ha SSP)
	20 (227 kg/ha SSP)
Placement	IBS (spread on soil surface and incorporated by sowing)
	Seed (in-furrow with seed)

SSP = single superphosphate (0% N, 8.8% P, 11% S)
Gypsum was applied at 0.5 t/ha pre-sowing to ensure adequate sulphur (S) supplies across treatments.

Results

Crop establishment

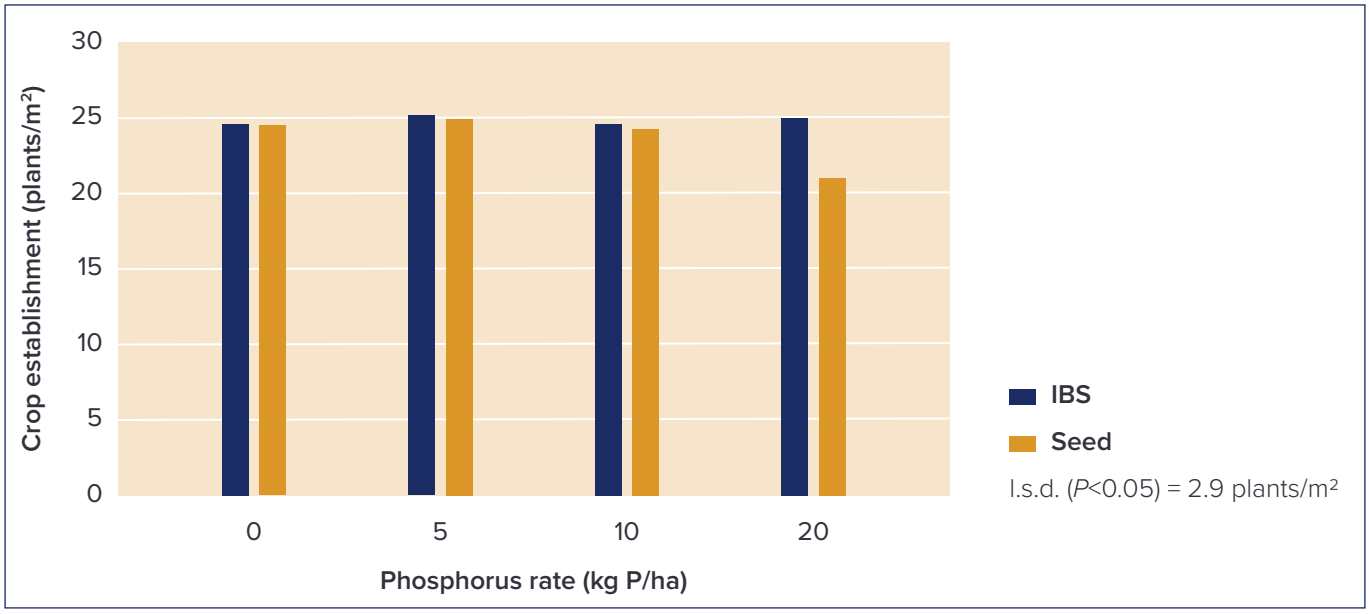


Figure 13: *Effect of phosphorus rate (applied as single superphosphate) and placement on PBA Samira(ф) faba bean establishment at Ganmain in 2021.*

Yield

Table 16: *Effect of phosphorus rate (applied as single superphosphate) on grain yield of PBA Samira(ф) faba beans at Ganmain in 2021.*

Phosphorus Rate (kg P/ha)	Yield (t/ha)
0	4.6
5	4.9
10	4.9
20	4.9
l.s.d. (*P*<0.05)	0.26

Chickpea inoculant and nutrient management

Ganmain 2021

Key findings

- Application of inoculant (standard peat rhizobia) increased nodulation on CBA Captain$^{\phi}$, but there was minimal effect of crop nutrition (N and P) on nodulation.
- Inoculation increased crop biomass, even where 40 kg/ha N was applied. N application only increased biomass where inoculant was not applied.
- Increasing P rate from 5 to 15 kg P/ha did not affect crop biomass.
- The trial was not harvested for grain due a hailstorm.
- Biomass samples are being processed to determine the amount of N-fixation in the nil N treatments.

Trial details

Table 17: *Trial management and treatments applied at Ganmain in 2021.*

Management	
Sowing Date	19 May
Soil phosphorus 0-10 cm (Colwell)	73 mg/kg
Soil pH ($CaCl_2$)	5.3
Gypsum	0.5 t/ha pre-sowing to ensure adequate sulphur
Cultivar	CBA Captain$^{\phi}$
Treatment	**Description**
Phosphorus (at sowing)	5 kg/ha (57 kg/ha SSP*)
	15 kg/ha (171 kg/ha SSP*)
Nitrogen	Nil
	40 kg/ha (broadcast pre-sow)
Inoculant	Nil
	Standard peat rhizobia

* SSP = single superphosphate (0% N, 8.8% P, 11% S).

Results

Nodulation

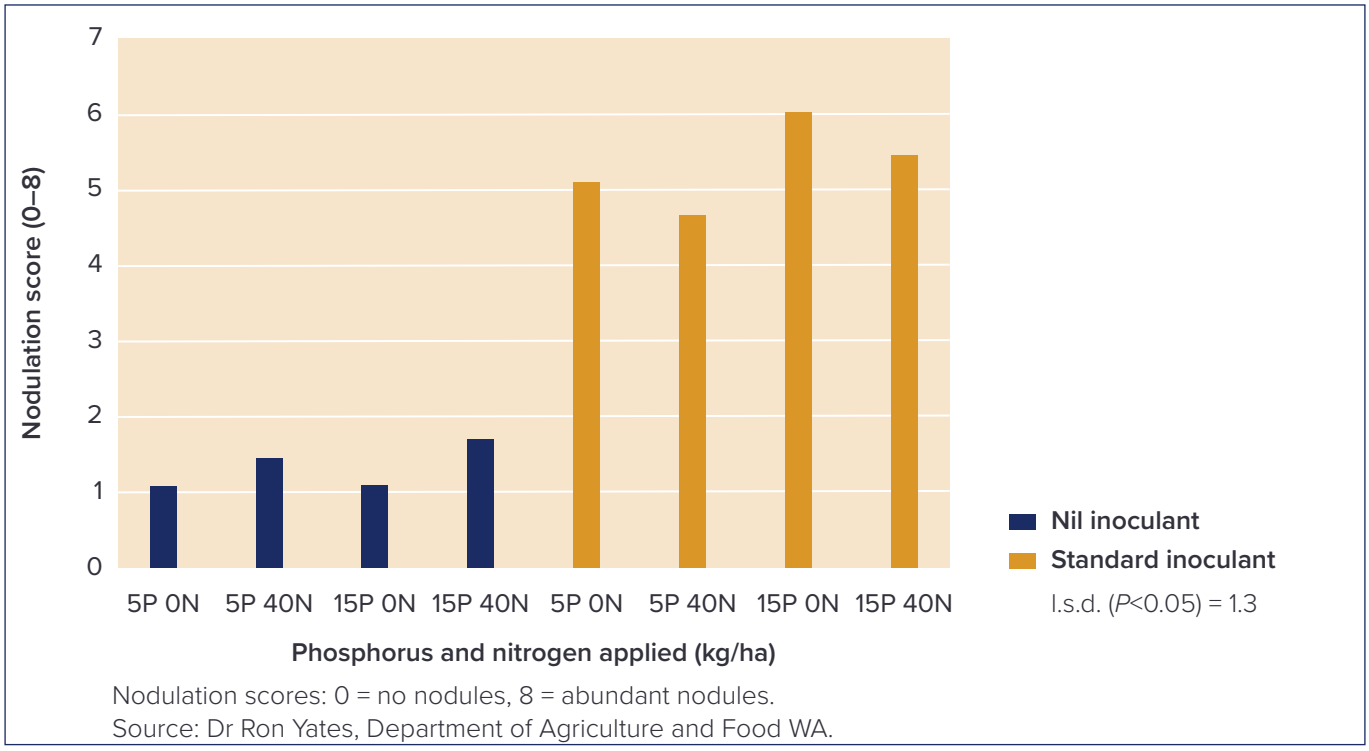


Figure 14: *Effect of nutrition and inoculation on nodulation score of CBA Captain$^{\phi}$ chickpeas at Ganmain in 2021.*

Biomass

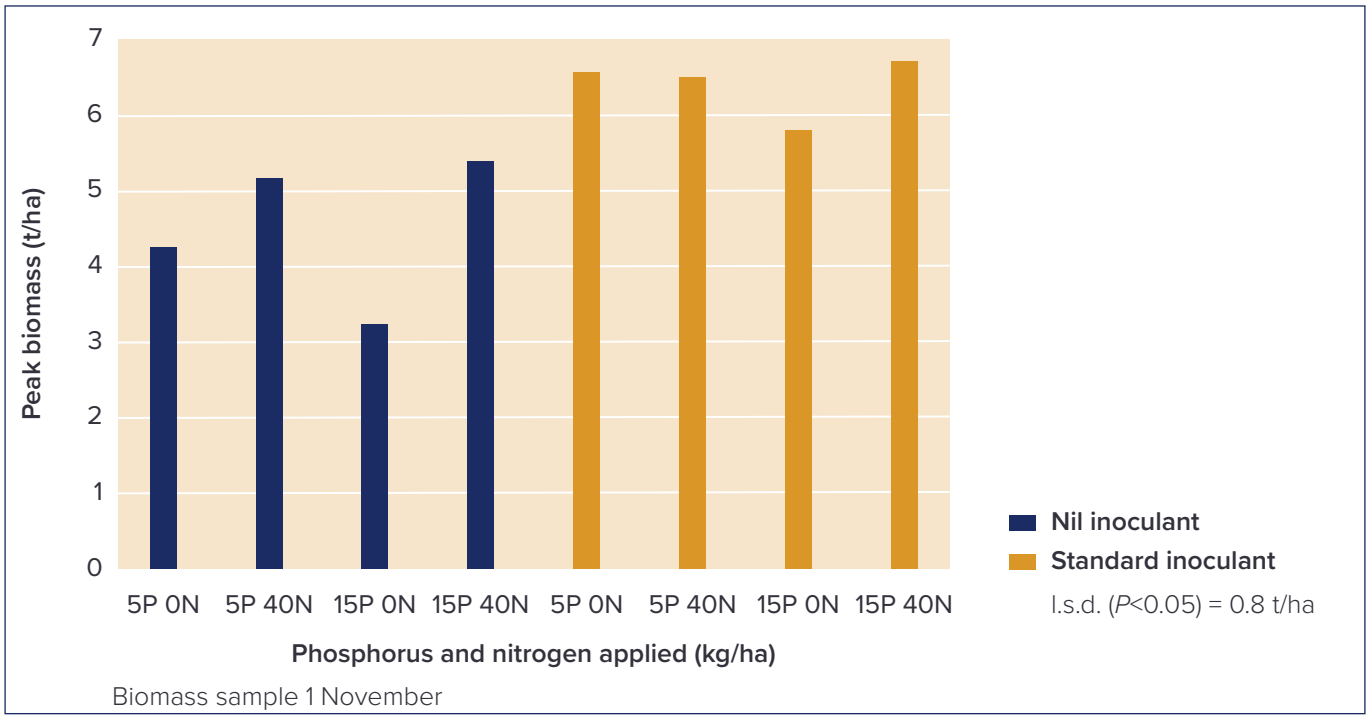


Figure 15: *Effect of nutrition and inoculation on peak biomass of CBA Captain$^{\phi}$ chickpeas at Ganmain in 2021.*

Figure 16: *The importance of inoculation for biomass production. Chickpeas on the left were not inoculated and had 15 kg P/ha applied and no nitrogen, while on the right they were inoculated with standard peat rhizobia and had 5 kg P/ha and no nitrogen.*

Faba bean disease management

Ganmain and Caragabal 2021

Key findings

- Fungicide reduced but did not control chocolate spot infection in PBA Nasma$^{\phi}$ and PBA Samira$^{\phi}$ at both Ganmain and Caragabal.
- PBA Nasma generally had more chocolate spot infection than PBA Samira$^{\phi}$ but the fungicide response was similar for both varieties.
- Faba bean yield was very high at both sites, with an average yield of 4.4 t/ha and 5.0 t/ha at Ganmain and Caragabal respectively.
- PBA Samira$^{\phi}$ (4.7 t/ha) yielded more than PBA Nasma$^{\phi}$ (4.1 t/ha) at Ganmain but the yield of the two varieties was similar (5.0 t/ha) at Caragabal.
- Fungicide response overall was modest, with 0.4 t/ha and 0.3 t/ha increase in grain yield from a 'Complete' fungicide program compared to 'Nil' fungicide at Ganmain and Caragabal respectively.
- 'Budget' fungicide management increased yield compared to the untreated control and there were no further yield increases from 'Complete' fungicide management at either site.

Trial details

Table 18: *Sowing date, variety and fertiliser details, and fungicide management strategies applied at Ganmain and Caragabal in 2021.*

Management	Ganmain			Caragabal		
Sowing date	28 April			29 April		
Variety	PBA Nasma$^{\phi}$ and PBA Samira$^{\phi}$					
Starter fertiliser	170 kg/ha single super					
Fungicide strategy	**Date applied**	**Rate**	**Product***	**Date applied**	**Rate**	**Product***
Nil	Nil			Nil		
Budget	14 June	1.0 kg/ha	Mancozeb	14 June	1.0 kg/ha	Mancozeb
	21 August	0.5 L/ha	Carbendazim	22 August	0.5 L/ha	Carbendazim
Delayed	17 September	0.6 L/ha	Aviator® Xpro®		N/A	
Complete	14 June	1.0 kg/ha	Mancozeb	14 June	1.0 kg/ha	Mancozeb
	21 August	0.6 L/ha	Aviator® Xpro®	13 July	1.0 kg/ha	Mancozeb
	28 September	0.5 L/ha	Carbendazim	22 August	0.6 L/ha	Aviator® Xpro®
	11 October	0.5 L/ha 1.0 L/ha	Carbendazim + Chlorothalonil	27 September	0.5 L/ha 1.0 L/ha	Carbendazim + Chlorothalonil
				19 October	0.5 L/ha + 1.0 L/ha	Carbendazim Chlorothalonil

* Mancozeb = 750 g/kg mancozeb; Carbendazim = 500 g/L carbendazim; Aviator® Xpro® = 75 g/L bixafen and 150 g/L prothioconazole; Chlorothalonil = 720 g/L chlorothalonil.

Results

Chocolate spot infection

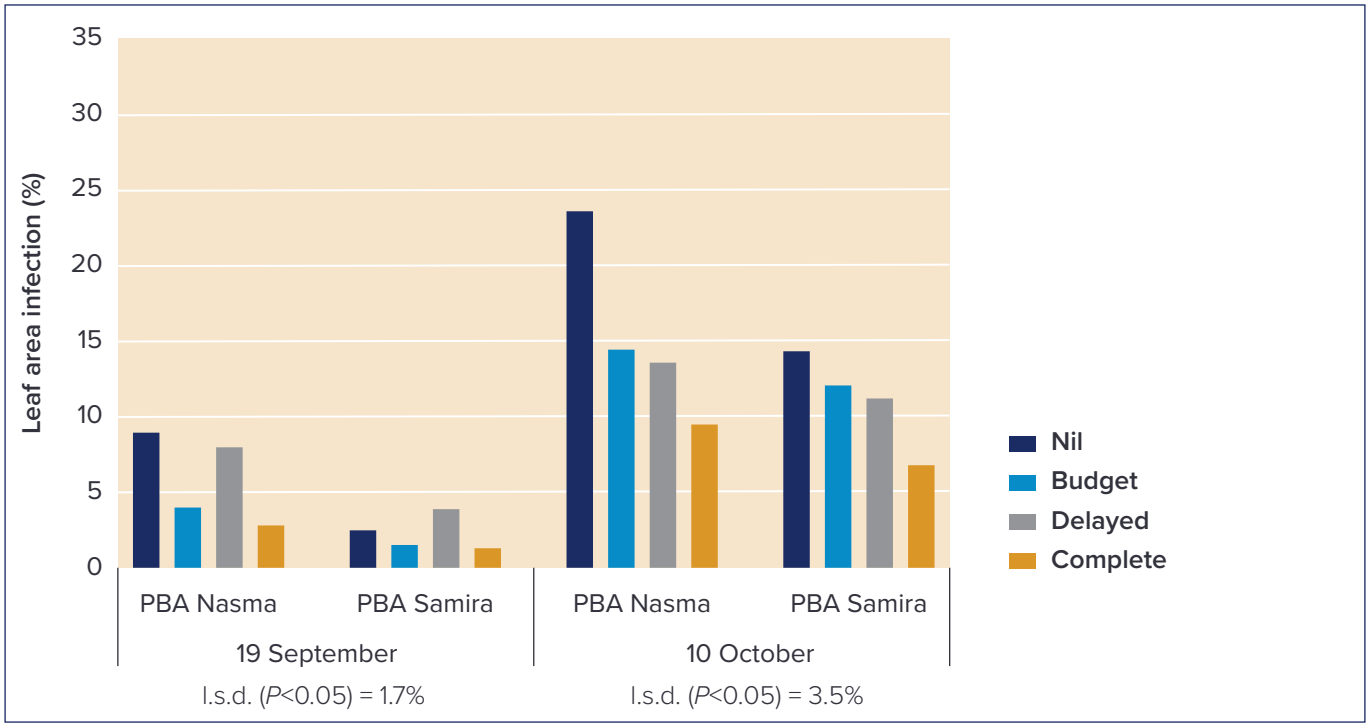


Figure 17: *Effect of fungicide management on chocolate spot infection on 19 September and 10 October at Ganmain in 2021.*

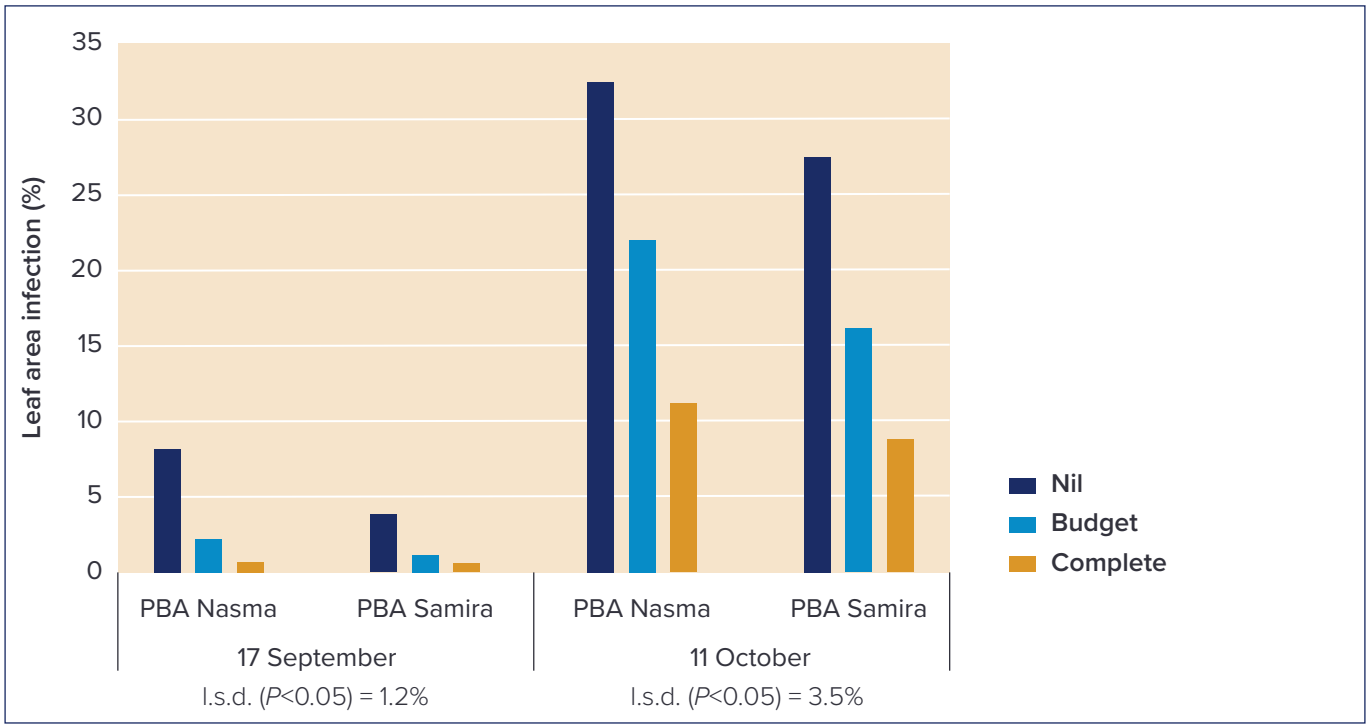


Figure 18: *Effect of fungicide management on chocolate spot infection on 17 September and 11 October at Caragabal in 2021.*

Table 19: *Grain yield of PBA Nasma and PBA Samira with four (Ganmain) and three (Caragabal) fungicide management strategies in 2021.*

Fungicide strategy	Grain yield (t/ha) at Ganmain			Grain yield (t.ha) at Caragabal		
	PBA Nasma	PBA Samira	Mean	PBA Nasma	PBA Samira	Mean
Nil	3.8	4.4	4.1	4.6	4.9	4.7
Budget	4.3	4.6	4.4	5.3	5.2	5.2
Delayed	4.0	4.8	4.4	–	–	–
Complete	4.2	4.9	4.5	5.1	5.0	5.1
Mean (Variety)	*4.1*	*4.7*		*5.0*	*5.0*	
l.s.d. (*P*<0.05) Variety		0.21 t/ha			n.s.	
l.s.d. (*P*<0.05) Fungicide		0.30 t/ha			0.24 t/ha	
l.s.d. (*P*<0.05) Variety × Fungicide		n.s.			n.s.	

Figure 19: *Covers were used to protect Nil fungicide plots from applications.*

Chickpea disease management

Ganmain and Caragabal 2021

Key findings

- Ascochyta blight was detected at both Ganmain and Caragabal, with infection observed in the *Complete* fungicide treatment.
- CBA Captain(ɸ) had less Ascochyta infection than PBA Slasher(ɸ) at Ganmain (only CBA Captain(ɸ) sown at Caragabal).
- At both Ganmain and Caragabal, a *Complete* fungicide program and a *Budget* fungicide program reduced Ascochyta blight infection compared to the *untreated* control.
- At Caragabal, grain yield was highest with the *Complete* fungicide program (2.20 t/ha) with no difference between the *Budget* program and the *untreated* control.
- The Ganmain site was not harvested due to a hail storm on 18 December.

Trial details

Table 20: *Trial management and fungicide treatments applied at Ganmain and Caragabal in 2021.*

Management	Ganmain			Caragabal		
Sowing Date	19 May			19 May		
Starter fertiliser	170 kg/ha single super					
Fungicide strategy	Fungicide applied					
	Date	Rate	Fungicide	Date	Rate	Fungicide
Nil		Nil			Nil	
Budget	30 June	1 kg/ha	Mancozeb	13 July	1 kg/ha	Mancozeb
	17 September	1 L/ha	Chlorothalonil	15 September	1 L/ha	Chlorothalonil
Delayed	28 September	0.6 L/ha	Aviator® Xpro		N/A	
Complete	30 June	1 kg/ha	Mancozeb	13 July	1 kg/ha	Mancozeb
	21 August	1 kg/ha	Mancozeb	22 August	1 kg/ha	Mancozeb
	17 September	0.6 L/ha	Aviator® Xpro	15 September	0.6 L/ha	Aviator® Xpro
	28 September	1 L/ha	Chlorothalonil	27 September	0.5 L/ha 1 L/ha	Carbendazim + Chlorothalonil
	11 October	0.5 L/ha 1 L/ha	Carbendazim + Chlorothalonil	19 October	0.5 L/ha 1 L/ha	Carbendazim + Chlorothalonil

* Mancozeb = 750 g/kg mancozeb; Carbendazim = 500 g/L carbendazim; Aviator® Xpro® = 75 g/L bixafen and 150 g/L prothioconazole; Chlorothalonil = 720 g/L chlorothalonil.

Results

Ascochyta blight infection

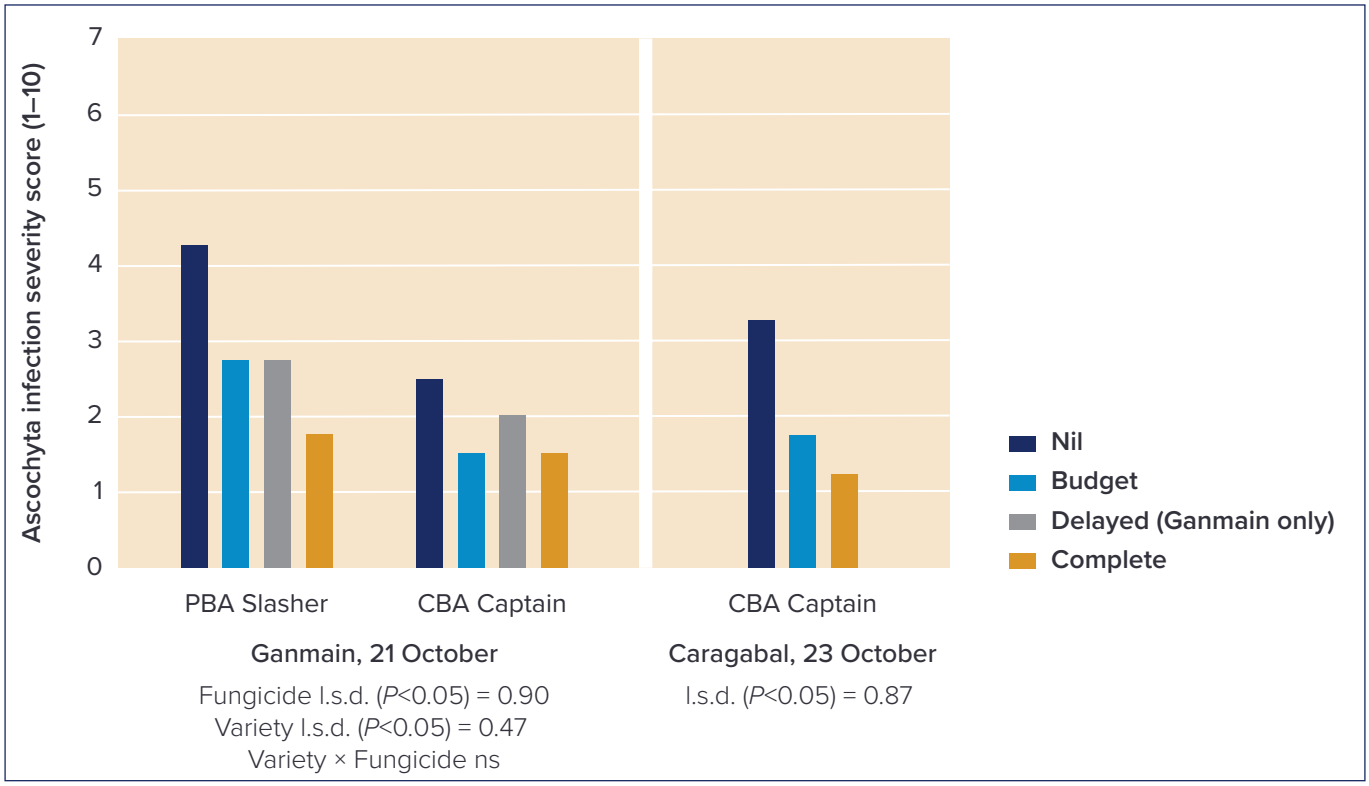


Figure 20: *Effect of fungicide management on Ascochyta blight infection in late October at Ganmain and Caragabal in 2021.*

Figure 21: *Ascochyta blight infection on chickpea stem (left) and leaf (right).*

Grain yield

Only Caragabal harvested due to hail storm causing crop damage at Ganmain on 18 December.

Table 21: *Grain yield of CBA Captain with three fungicide strategies at Caragabal in 2021.*

Fungicide strategy	Yield (t/ha)
Nil	1.62
Budget	1.77
Complete	2.20
Fungicide l.s.d. (P<0.05)	0.37

Buraja

Buraja site attributes
2021

Soil chemical characteristics

Sampled 30 June

Characteristic	Unit	Soil depth 0–10 cm
Soil colour		Brown
Soil texture		Clay
pH ($CaCl_2$)		4.6
Organic Carbon	%	1.1
Phosphorus (Colwell)	mg/kg	55
Potassium	mg/kg	290
Nitrate N	mg/kg	37.0
Ammonium N	mg/kg	1.9
Conductivity (Sat. Ext.)	dS/m	0.7
Cation Exchange Capacity	cmol(+)/kg	8.9
Exchangeable calcium	%	61
Exchangeable magnesium	%	24
Exchangeable potassium	%	8.2
Exchangeable sodium	%	3.2
Exchangeable aluminium	%	3.9
Zinc (DTPA)	mg/kg	0.66
Copper (DTPA)	mg/kg	1.60
Iron (DTPA)	mg/kg	160.0
Manganese (DTPA)	mg/kg	30.0
Boron (Hot $CaCl_2$)	mg/kg	1.0

Crop sequence and key management dates

Crop sequence		
Year	Crop	Cultivar
2020	Wheat	Scepter$^{\Phi}$
2019	Wheat	Longsword$^{\Phi}$
2018	Canola	Triazine tolerant

Site management		
Activity	Date	Comments
Sowing	28 April	Faba beans disease management Chickpea disease management Faba bean and vetch biomass
Harvest	23 December	

Seasonal conditions

Corowa temperature and rainfall

Corowa is the nearest weather station located 25 km south of trial site.

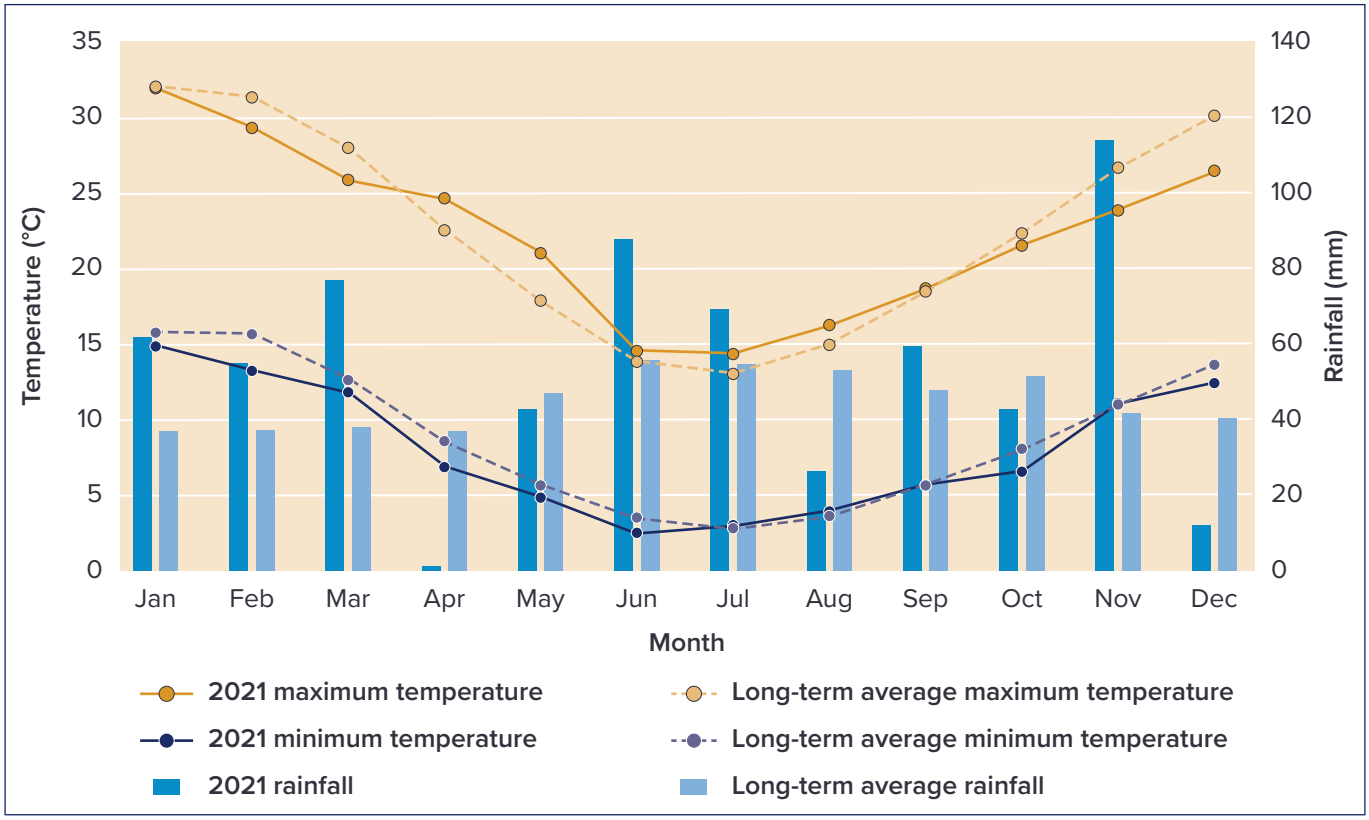


Figure 22: *Rainfall and temperature data for Corowa in 2021.*

Figure 23: *Discussing faba bean biomass at the Buraja field day in 2021.*

Vetch and faba bean biomass

Buraja 2021

Key findings

- Faba beans produced more dry matter than vetch (7.64 v 6.32 t/ha), however nutrition treatment did not influence peak biomass levels.
- Highest grain yield for faba beans (PBA Nasma(ф)) was just over 3.5 t/ha compared with 1.2 t/ha for vetch (Popany).
- Faba bean yield increased by 0.85 t/ha when inoculated with rhizobia compared to no inoculation, where no extra nutrition was supplied.
- The addition of nitrogen reduced nodulation but did not affect yield.
- The addition of experimental FAR PGR21-1 to vetch increased crop height, while PGR21-2 had a shortening effect on faba beans.
- Inoculation was more important than crop nutrition, suggesting inoculated crops were capable of supplying sufficient nitrogen for growth at this site.

Trial details

Table 22: *Sowing date, fertiliser and variety details at Buraja in 2021.*

Management	Buraja faba bean disease management trial
Sowing date	7 May
Starter fertiliser	80 kg/ha MAP
Species, variety	Vetch, Popany
	Faba bean, PBA Nasma(ф)
Harvest date	23 December

Table 23: *Details of treatment components of the vetch and faba bean biomass trial at Buraja in 2021.*

Treatment name	Description	Application method	Application rate
Inoculant	Nodulator® granular inoculant	With seed	8.4 kg/ha
TE	Trace elements: Smartrace Triple (4% zinc, 5% manganese, 1.5% copper, 4.9% sulphur)	Foliar with Moly	2.5 L/ha
Moly	Boly 5:3 (3% nitrogen, 5% boron, 3% molybdenum)	Foliar with TE	2 L/ha
100 N	Urea (46% nitrogen)	Spread	109 kg urea/ha
200 N	Urea (46% nitrogen)	Spread	217 kg urea/ha
PGR	Plant growth regulator (FAR PGR21-1 on vetch, FAR PGR21-2 on faba beans)	Foliar	

Treatment summary for vetch and faba bean biomass trial.

Crop stage	Sowing	4–6 Node				Vegetative	Pre-flower			
Date applied	7 May	7 July				29 July	26 August			
Treatment	Inoculant	100N	200N	TE	Moly	PGR	100N	200N	TE	Moly
Nil										
Inoculant only	■									
Inoc + TE + Moly	■			■	■				■	■
Inoc + TE + Moly + 100N	■	■		■	■		■		■	■
Inoc + TE + Moly + 100N + PGR	■	■		■	■	■	■		■	■
Inoc + TE + Moly + 200N	■		■	■	■			■	■	■

Yellow shading indicates product applied at that time to the treatment

Results

Biomass and nodulation

Table 24: *Influence of nutrition and pulse species on peak biomass production at Buraja in 2021.*

Treatment	Peak biomass (t/ha)*		
	Vetch (R3)	Faba bean (GS78)	Mean
Nil	6.64	6.28	*6.46*
Inoculant only	6.73	8.58	*7.66*
Inoc + TE + Moly	5.74	8.21	*6.97*
Inoc + 100 N + TE + Moly	6.92	7.52	*7.22*
Inoc + 100 N + TE + Moly + PGR	6.89	7.85	*7.37*
Inoc + 200 N + TE + Moly	5.00	7.41	*6.20*
Mean	*6.32*[b]	*7.64*[a]	
Species l.s.d (*P* = 0.05)	0.58	*P* val = 0.006	
Nutrition l.s.d. (*P* = 0.05)	ns	*P* val = 0.642	
Species x Nutrition l.s.d. (*P* = 0.05)	ns	*P* val = 0.633	

* Numbers with the same letter are not significantly different from each other.
Biomass assessed 25 October.

Figure 24: *Vetch biomass plots at Buraja in 2021.*

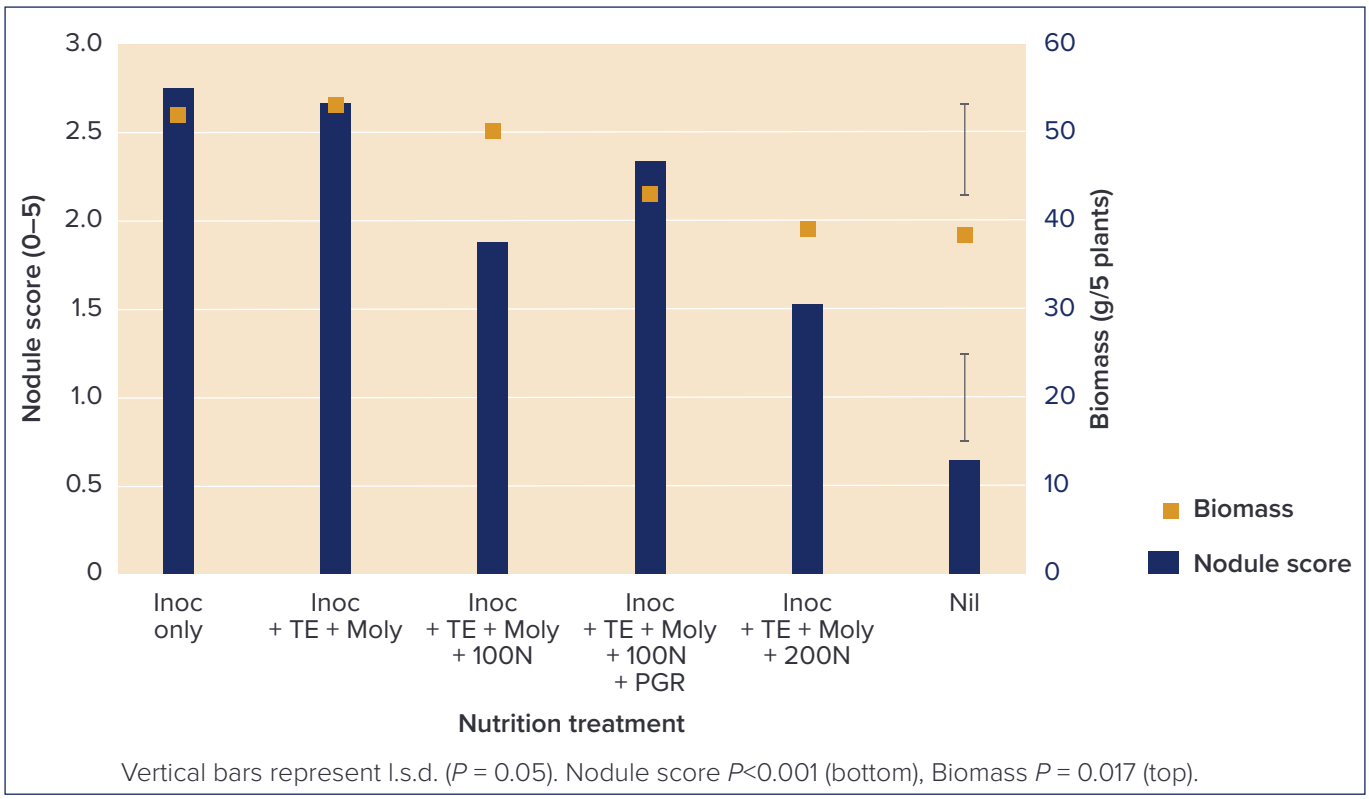


Figure 25: *Influence of nutrient management on faba bean root nodules (0–5 score, where 0 = no nodules and 5 = abundant nodules) and biomass at Buraja in 2021.*

Canopy height

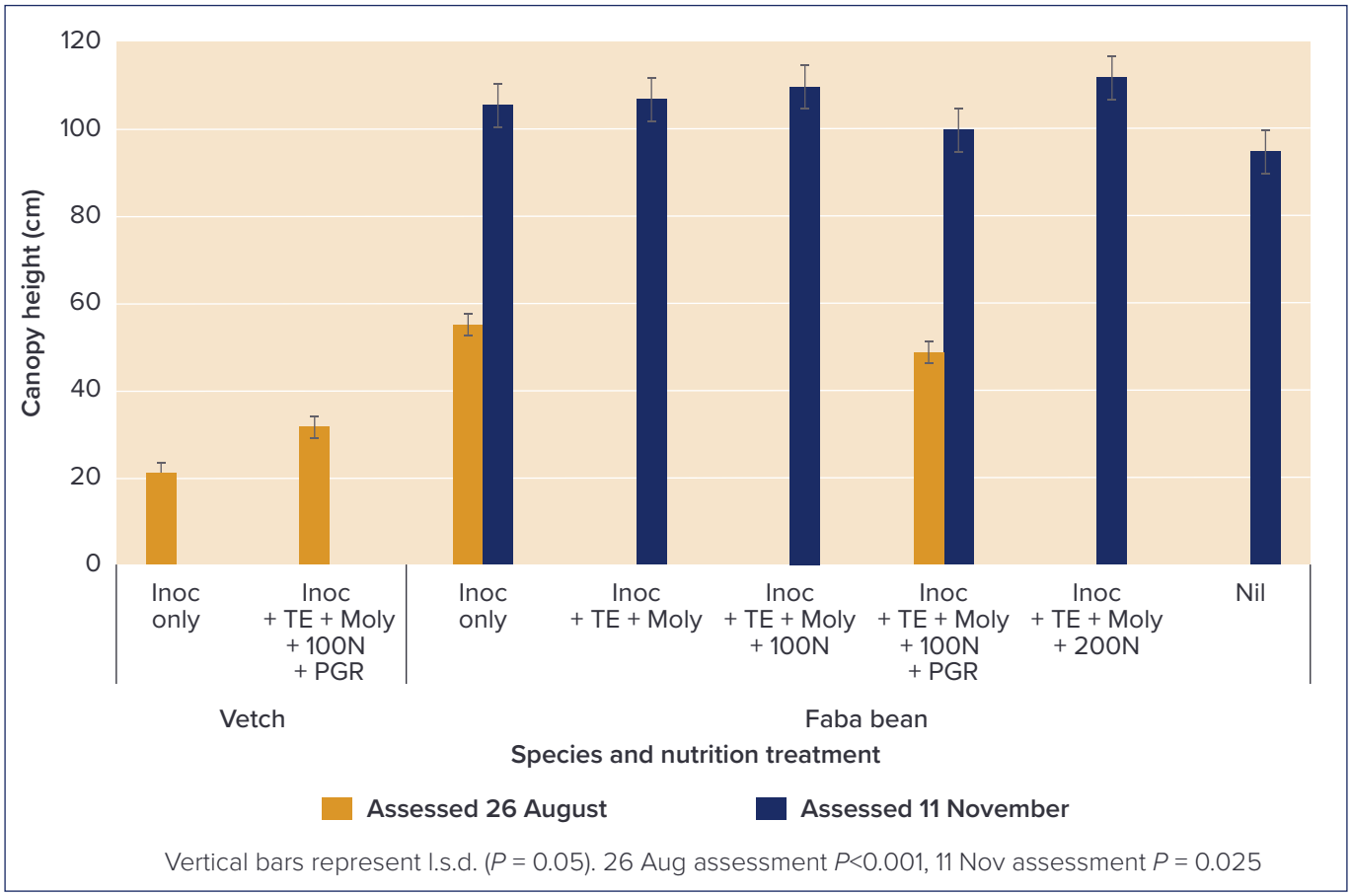


Figure 26: *Influence of plant growth regulators and nutrient management on crop canopy height (cm) of vetch and faba beans at Buraja in 2021.*

Grain yield

Table 25: *Effect of nutrient management on grain yield (t/ha) of vetch and faba beans at Buraja in 2021.*

Treatment	Grain Yield (t/ha)		
	Vetch	Faba bean	Mean
Inoculant only	1.04	3.35	*2.19^{ab}*
Inoc + TE + Moly	0.98	3.20	*2.09^{abc}*
Inoc + TE + Moly + 100N	1.21	3.55	*2.38^{a}*
Inoc + TE + Moly + 100N + PGR	0.92	2.99	*1.95^{bc}*
Inoc + TE + Moly + 200N	0.94	2.93	*1.93^{bc}*
Nil	1.05	2.50	*1.78^{c}*
Mean	*1.02^{b}*	*3.09^{a}*	
Species l.s.d (*P* = 0.05)	0.17	*P* val<0.001	
Nutrition l.s.d. (*P* = 0.05)	0.32	*P* val=0.008	
Species x Nutrition l.s.d. (*P* = 0.05)	ns	*P* val=0.071	

* Numbers with the same letter are not significantly different from each other

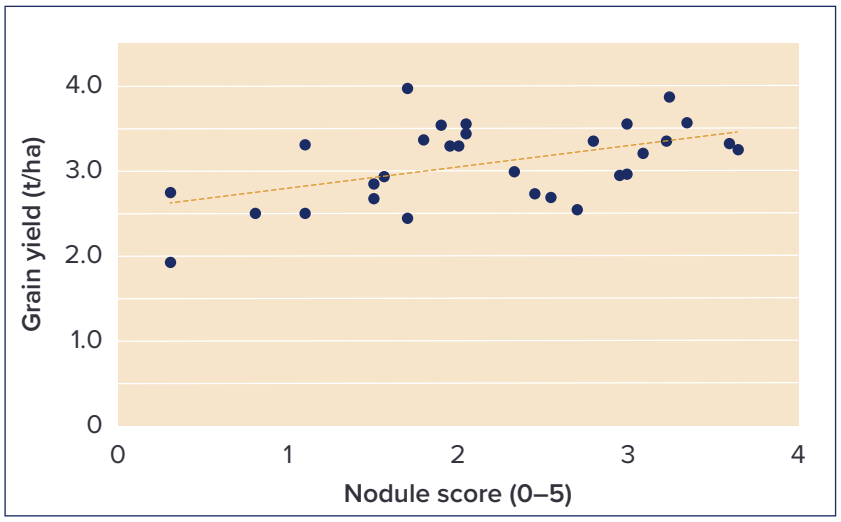


Figure 27: *Relationship between nodule score and grain yield of faba beans at Buraja in 2021.*

Faba bean disease management

Buraja 2021

Key findings

- When disease (primarily chocolate spot) was controlled, there was no yield difference between PBA Amberley$^{\phi}$ and PBA Bendoc$^{\phi}$, but different fungicide strategies could be adopted in each cultivar to achieve peak yields
- There was no effect of fungicide on yield of the moderately resistant (MR) variety PBA Amberley$^{\phi}$, whereas a minimum of two fungicide applications was required on the susceptible (S) PBA Bendoc$^{\phi}$.
- These results highlight the importance of disease resistance to reduce reliance on fungicides, and the need for more intense fungicide management in susceptible cultivars.
- The application of fungicides reduced disease incidence in the sprayed canopy layers, which in turn reduced disease infection above the layer of fungicide application.
- A two-spray strategy incorporating a new generation SDHI (succinate dehydrogenase inhibitor) fungicide (Miravis® Star) didn't improve disease control or grain yield compared to the more traditional 2-spray strategy using chlorothalonil and carbendazim.
- Further trial work across multiple environments will provide greater confidence in the use of new generation fungicide products.

Trial details

Table 26: *Sowing date, fertiliser and variety details at Buraja in 2021.*

Management	Buraja faba bean disease management trial
Sowing date	7 May
Starter fertiliser	80 kg/ha MAP
Variety (chocolate spot disease rating)	PBA Bendoc$^{\phi}$ (suseptable, S)
	PBA Amberley$^{\phi}$ (moderately resistant, MR)
Harvest date	23 December

Table 27: *Fungicide management strategies applied at Buraja in 2021.*

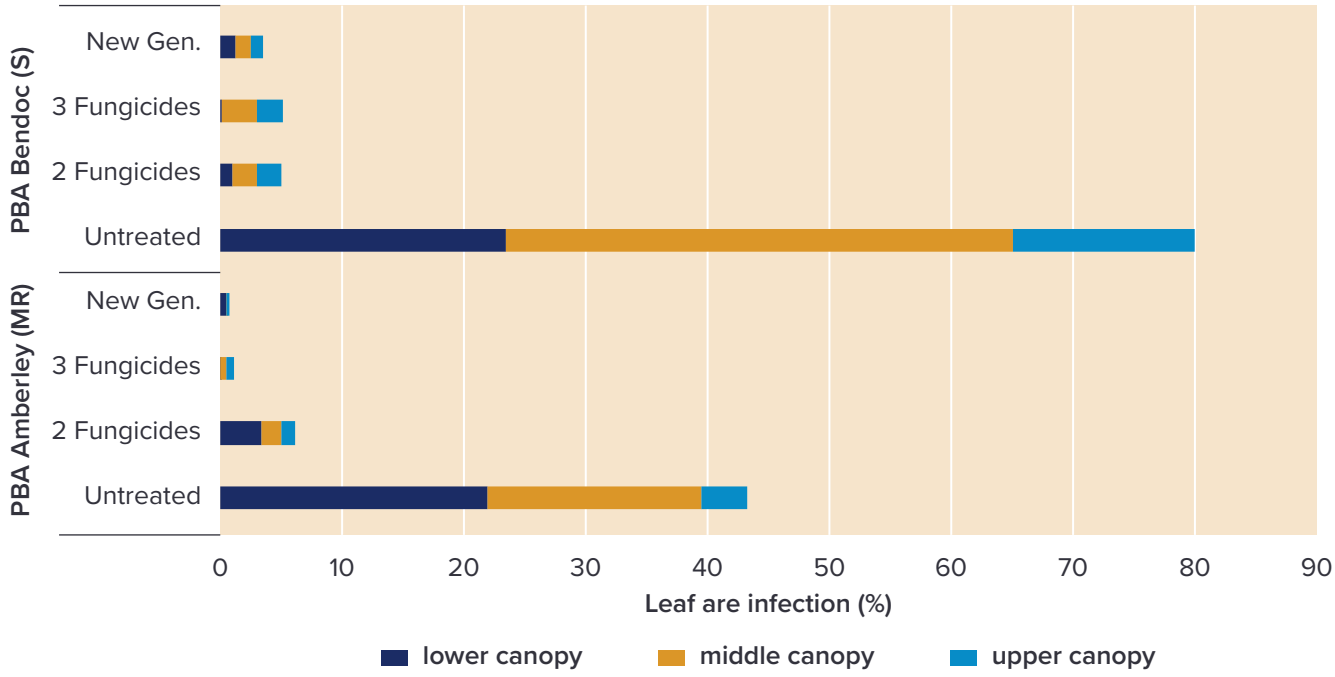
Fungicide strategy	First flower Product* (rate)	14 days after first flower Product* (rate)	28 days after first flower Product* (rate)
Untreated	–	–	–
1 fungicide	–	–	Chlorothalonil (1500 mL/ha) + Carbendazim (500 mL/ha)
2 fungicides	–	Chlorothalonil (2300 mL/ha) + Carbendazim (500 mL/ha)	Chlorothalonil (1500 mL/ha) + Carbendazim (500 mL/ha)
3 fungicides	Procymidone (240 g/ha)	Chlorothalonil (2300 mL/ha) + Carbendazim (500 mL/ha)	Chlorothalonil (1500 mL/ha) + Carbendazim (500 mL/ha)
New generation fungicides	–	Miravis® Star (750 mL/ha)	Veritas (750 mL/ha)
Date applied (growth stage)	26 August (GS61)	14 September (GS64)	14 October (GS75)

* Procymidone (500 g/kg procymidone); Chlorothalonil (720 g/L chlorothalonil); Carbendazim (500 g/L carbendazim); Miravis® Star (150 g/L fludioxonil + 100 g/L pydiflumetofen); Veritas® (120 g/L azoxystrobin + 200 g/L tebuconazole)
** New generation fungicides includes Miravis Star, a succinate dehydrogenase inhibitor (SDHI) fungicide

Results

Canopy disease

The faba bean canopy was tagged at each fungicide application, tag 1 at first spray, tag 2 at second and tag 3 at third spray. Each layer of the canopy was assessed to evaluate the impact of each fungicide application on the canopy levels it was applied to. By the end of the season tag 1 corresponds to lower canopy, tag 2 middle canopy, tag 3 upper canopy, and above tag 3 is unsprayed upper canopy.



Assessed 17 October . The *1 Fungicide* treatment was applied on the same day so was not assessed and assumed to be the same as untreated).

Figure 28: *Effect of fungicide strategy on levels of disease infection (chocolate spot) at different canopy levels at Buraja in 2021.*

Grain yield

Table 28: *Influence of faba bean cultivar and disease management on grain yield (t/ha).*

	Grain Yield (t/ha)		
Cultivar (chocolate spot disease rating)	**PBA Amberley (MR)**	**PBA Bendoc (S)**	**Mean**
Fungicide strategy			
Untreated	3.75 [ab]	3.17 [c]	3.46
1 Fungicide	3.61 [ab]	3.40 [bc]	3.50
2 Fungicide	3.78 [a]	3.80 [a]	3.79
3 Fungicide	3.72 [ab]	3.97 [a]	3.84
SDHI	3.76 [ab]	3.75 [ab]	3.76
Mean	*3.72*	*3.62*	
Cultivar l.s.d. (*P* = 0.05)	ns	P val	0.169
Fungicide Strategy l.s.d. (*P* = 0.05)	0.26	P val	0.013
Cultivar x Fungicide Strategy l.s.d. (*P* = 0.05)	0.36	P val	0.033

Chickpea disease management

Buraja 2021

Key findings

- The application of fungicide reduced infection of Botrytis Grey Mould (BGM) compared to the untreated control. Ascochyta blight was not observed in this trial.
- Despite high levels of disease infection, the control of BGM did not increase yield.
- Grain yields above 2 t/ha were achieved with all treatments.

Trial details

Table 29: *Sowing date, fertiliser and variety details and treatment summary at Buraja in 2021.*

Management	Buraja chickpea disease management trial		
Sowing date	7 May		
Starter fertiliser	80 kg/ha MAP		
Variety	CBA Captain(ϕ)		
Harvest date	23 December		
Fungicide strategy	Product (rate per ha)		
	4–5 weeks post emergence	Pre-flower	Mid-flower
Untreated	–	–	–
Budget	Mancozeb (2 kg)	Chlorothalonil 720 (1000 mL)	Chlorothalonil 720 (1000 mL)
Complete	Veritas® (1000 mL)	Aviator® Xpro (600 mL)	Veritas® (1000 mL)
Date applied	7 July	26 August	14 October

Results

Disease and yield

Fungicide strategy	Botrytis Grey Mould infection (% plot, 1 December)	Grain yield (t/ha)
Untreated	80	2.02
Budget	37	2.16
Complete	50	2.30
l.s.d. (*P* = 0.05)	17.7	not significantly different

Barellan site attributes

2021

Soil characteristics

Sampled 10 August

Characteristic	Unit	Soil depth (cm)		
		0–10cm	10–20cm	20–60cm
Texture		sandy loam	sandy loam	clay
Colour		dark brown	red brown	red brown
NO3-N	ppm	6	7	6
NH4-N	ppm	2	-1	2
Phosphorus (Colwell)	ppm	97	24	5
Sulphur (MCP)	ppm	5	8	3
Manganese (DTPA)	ppm	47	36.5	2.8
Boron ($CaCl_2$)	ppm	1	1	2
Copper (DTPA)	ppm	0.6	0.6	0.5
Iron (DTPA)	ppm	22	13	2
Zinc (DTPA)	ppm	0.5	0.2	0.1
Organic Matter	%	1.9	1.3	0.6
CEC	meq/100g	6.39	7.69	10
K base saturation	%	20.5	14.8	11
Mg base saturation	%	12.7	13.8	18.1
Ca base saturation	%	63	69.4	69.9
Na base saturation	%	0.5	0.4	0.4
Al base saturation	%	3.3	1.6	0.5
pH (1:5 $CaCl_2$)		4.5	4.8	6.7
EC (1:5 H_2O)	dS/m	0.03	0.03	0.04
Chloride	ppm	50	36	57
Potassium	ppm	511	443	430
Magnesium	ppm	97	127	217

Crop sequence and key management dates

Crop sequence		
Year	Crop	Cultivar
2020	Wheat	Beckom(ф)
2019	Wheat	Beckom(ф)
2018	Canola	ATR Bonito(ф)
2017	Field peas	Sturt(ф)
2016	Barley	La Trobe(ф)

Site management		
Activity	Date	Comments
Sowing	13 May	Variety screen trial
		Rhizobia trial
		Phosphorus management trial
Harvest	9 December	Variety screen trial
		Rhizobia trial
		Phosphorus management trial

Rainfall

Table 30: *Rainfall at "Wanda Downs" and the post office in Baraellan in 2021, and the long-term average rainfall at the Barellan post office.*

Month	2021 Rainfall (mm)		
	Barellan "Wanda Downs"	Barellan Post Office	Barellan Post Office Long Term 1878–2021
January	112.0	96.2	38.3
February	37.0	53.8	34.3
March	121.0	116.8	37.6
April	0.0	0.0	34.4
May	66.5	62.2	37.3
June	74.5	85.8	40.4
July	34.5	40.2	36.7
August	15.0	15.1	37.8
September	78.5	76.0	34.9
October	32.0	31.0	42.5
November	134.5	143.6	34.3
December	1.0	8.0	31.7
Total	*706.5*	*728.7*	*440.2*
GSR (Apr–Oct)	*301.0*	*310.3*	*264.0*

Pulse species and variety comparison

Barellan 2021

Key findings

- The site chosen for the trial was a red sandy loam soil with inherent low fertility and an acidic topsoil, pH ($CaCl_2$) 4.5.
- In the lentil trial PBA Hallmark$^{\phi}$ had the highest grain yield (2.6 t/ha), higher than both PBA Highland$^{\phi}$ and PBA Kelpie$^{\phi}$. There was no difference in peak biomass between any of the varieties.
- Sturt$^{\phi}$ had the highest grain yield in the field pea trial (5.3 t/ha), with PBA Wharton$^{\phi}$ lower yielding (3.9 t/ha). PBA Wharton$^{\phi}$ also had a lower peak biomass (9.9 t/ha), compared to Sturt$^{\phi}$ (12.5t/ha) and PBA Taylor$^{\phi}$ (12.7 t/ha).
- CBA Slasher$^{\phi}$ yielded the highest in the chickpea trial (2.7 t/ha), with both CBA Slasher$^{\phi}$ (5.0 t/ha) and CBA Captain$^{\phi}$ (4.9 t/ha) having higher peak biomass than the kabuli variety PBA Royal$^{\phi}$.
- There were no differences in yield between varieties in the faba bean variety trial. PBA Samira$^{\phi}$ had the highest peak biomass of the faba bean varieties (9.4 t/ha).
- The Albus lupin variety Luxor$^{\phi}$ was the highest yielding variety in the lupin trial (3.0 t/ha), higher than both Murringo$^{\phi}$ and PBA Bateman$^{\phi}$.
- There were no differences in yield or biomass between varieties in the vetch trial.

Trial Details

Table 31: *Trial management and pulse species by variety assessed at Barellan in 2021.*

Management				
Pre-sow herbicides		13 May: 2 L/ha Crucial® (600 g/L glyphosate) + 20 g/ha Terrad'or® (700 g/kg tiafenacil) + 800g/ha Terbyne® (750 g/kg terbuthylazine) + 1.2 L/ha Treflan (480 g/L trifluralin) + Hasten (0.5 L/100 L)		
Sowing date		13 May		
Starter fertiliser		80 kg/ha SuPerfect® (phosphorus 8.8%, sulphate sulphur 11.0%, calcium 19%)		
Species	Target plant population (plant/m²)	Variety		
Lentils	100	PBA Hallmark XT$^{\phi}$	PBA Highland XT$^{\phi}$	PBA Kelpie XT$^{\phi}$
Vetch	40	Timok$^{\phi}$	Rasina$^{\phi}$	Volga$^{\phi}$
Field Pea	40	PBA Taylor$^{\phi}$	Sturt$^{\phi}$	PBA Wharton$^{\phi}$
Lupin	30–40	PBA Bateman$^{\phi}$	Murringo$^{\phi}$	Luxor
Chickpea	40	CBA Captain$^{\phi}$	PBA Slasher$^{\phi}$	PBA Royal$^{\phi}$
Faba bean	20	PBA Samira$^{\phi}$	PBA Marne$^{\phi}$	PBA Nasma$^{\phi}$

Results

Peak Biomass

Table 32: *Peak biomass (measured at early to mid podding) of each pulse species by variety at Barellan in 2021.*

Variety	Peak biomass (t/ha)
Chickpeas	
CBA Captain	4.9
PBA Royal	3.7
CBA Slasher	5.0
l.s.d. (*P*<0.05)	0.68
Lentils	
PBA Hallmark	6.8
PBA Highland	5.2
PBA Kelpie	5.1
l.s.d. (*P*<0.05)	n.s.

Variety	Peak biomass (t/ha)
Faba beans	
PBA Marne	6.3
PBA Nasma	7.0
PBA Samira	9.4
l.s.d. (*P*<0.05)	1.20
Lupins	
Luxor	5.5
Murringo	6.3
PBA Bateman	*
l.s.d. (*P*<0.05)	n.s.

Variety	Peak biomass (t/ha)
Field peas	
PBA Taylor	12.7
PBA Wharton	9.9
Sturt	12.5
l.s.d. (*P*<0.05)	1.60
Vetch	
Rasina	8.6
Timok	9.3
Volga	8.9
l.s.d. (*P*<0.05)	n.s.

Figure 29: *Discussing vetch plots at a field day held at the Barellan site, 14 October 2021.*

Grain Yield

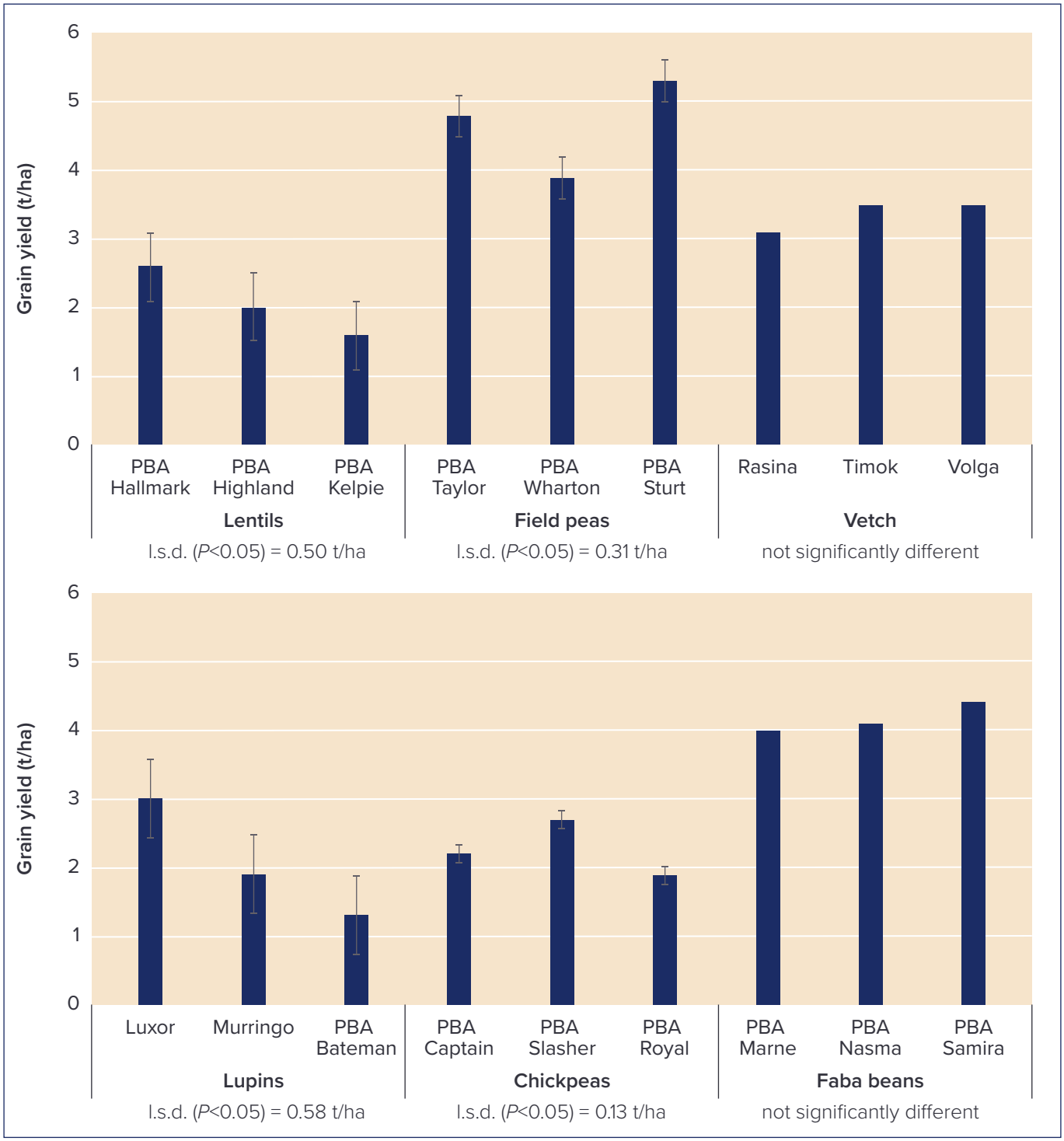


Figure 30: *Grain yield of each pulse species by variety at Barellan in 2021.*

Managing N fixation in pulses

Barellan 2021

Key findings

- The site chosen was a red sandy loam soil with inherent low fertility and an acidic topsoil, pH ($CaCl_2$) 4.5. Field peas were last grown in 2017.
- Nodulation was greatest in both lentils and field peas where seeds were inoculated (standard or acid tolerant rhizobia) and no N was applied.
- Standard peat and acid tolerant rhizobia strain (regardless of N treatment) had greater nodulation over the Nil in both the lentil and field pea trial.
- In lentils the acid tolerant rhizobia strain resulted in the highest peak biomass (8.01 t/ha), 1.24 t/ha more than standard peat.
- In lentils yield was higher in both the standard and acid tolerant rhizobia than uninoculated. Nitrogen application increased yield by an average of 0.29 t/ha (averaged across inoculation treatments).
- In field peas, there was no difference in grain yield between inoculation treatments or nitrogen treatments.

Trial Details

Table 33: *Trial management and treatments applied at Barellan in 2021.*

Management	
Pre-sow herbicides	13 May: 2 L/ha Crucial® (600 g/L glyphosate) + 20 g/ha Terrad'or® (700 g/kg tiafenacil) + 800g/ha Terbyne® (750 g/kg terbuthylazine) + 1.2 L/ha Treflan (480 g/L trifluralin) + Hasten (0.5 L/100 L)
Sowing date	13 May
Starter fertiliser	80 kg/ha Superfect® (phosphorus 8.8%, sulphate sulphur 11.0%, calcium 19%)
Sowing rate	Calculated to target 100 lentil plants/m^2 and 40 field pea plants/m^2
Fungicide	2 September – 1 L/ha Miravis® Star
Harvest date	9 December
Treatments	
Species, variety	Lentils, PBA Hallmark XT(ϕ)
	Field Peas, Sturt(ϕ)
Rhizobia inoculant	Nil
	Standard strain peat
	Acid tolerant strain peat
N rate (as urea)	0 kg N/ha
	40 kg N/ha

Results

Lentils

Table 34: *Nodulation scores*, peak biomass and grain yield of lentils at Barellan in 2021.*

Treatment	Nodule Score*	Biomass (t/ha)	Grain yield (t/ha)
Inoculation			
Nil	1.47	6.55	2.60
Standard	3.62	6.77	3.00
Acid tolerant	3.62	8.01	3.20
l.s.d. (*P*<0.05)	2.07	1.14	0.28
Nitrogen			
0 N	3.14	6.93	2.82
40 N	2.67	7.29	3.11
l.s.d. (P<0.05)	n.s.	n.s.	0.17

* Nodulation scores 0 to 8, where 0 = no nodules and 8 = extremely abundant. A score of 4 is considered adequate.
Source: Dr Ron Yates, Department of Agriculture and Food WA.

Figure 31: *Poor growth of uninoculated field peas with no applied nitrogen (left) compared with field peas inoculated with the standard strain of rhizobia plus 40 kg N/ha applied (right).*

Field Peas

Table 35: *Nodulation scores* and grain yield of field peas at Barellan in 2021.*

Treatment	Nodule Score*	Grain Yield (t/ha)
Inoculation		
Nil	2.81	5.15
Standard	3.81	5.43
Acid tolerant	4.10	5.39
l.s.d. (*P*<0.05)	0.92	n.s.
Nitrogen		
0N	4.02	5.38
40N	3.13	5.27
l.s.d. (*P*<0.05)	0.30	n.s.

* Nodulation scores 0 to 8, where 0 = no nodules and 8 = extremely abundant. A score of 4 is considered adequate.
Source: Dr Ron Yates, Department of Agriculture and Food WA.

Phosphorus management

Barellan 2021

Key findings

- The site chosen for the trial was a red sandy loam soil with inherent low fertility and an acidic topsoil, pH ($CaCl_2$) 4.5.
- Establishment was reduced in both the lentil and lupin trials where phosphorus (11 and 22 kg P/ha) was placed with the seed.
- The greatest impact on establishment was in lupins where the higher P rate (22 kg P/ha) was placed with the seed.
- In the lentil trial, yield was greater where P was applied with the seed (3.25 t/ha) as opposed to IBS (incorporated by sowing, 3.09 t/ha). Yield was also higher where the higher rate of P (22 kg P/ha) was applied (3.55 t/ha), despite the reduction in plant numbers.
- In the lupin trial there were no differences in yield between P rate and P placement.

Trial Details

Table 36: *Trial management and phosphorus treatments applied at Barellan in 2021.*

Management	
Pre-sow herbicides	13 May: 2 L/ha Crucial® (600 g/L glyphosate) + 20 g/ha Terrad'or® (700 g/kg tiafenacil) + 800g/ha Terbyne® (750 g/kg terbuthylazine) + 1.2 L/ha Treflan (480 g/L trifluralin) + Hasten (0.5 L/100 L)
Sowing date	13 May
Starter fertiliser	As per treatment
Sowing rate	Calculated to target 80 lentil plants/m^2 and 30 lupin plants/m^2
Fungicide	2 September – 1 L/ha Miravis® Star
Harvest date	9 December
Treatments	
Species, variety	Lentils, PBA Hallmark XT(ф)
	Lupins, PBA Bateman(ф)
Phosphorus placement	IBS (spread and incorporated by sowing)
	With Seed
Phosphorus rate	0 kg P/ha
	11 kg P/ha
	22 kg P/ha

Results

Establishment and yield

Table 37: *Effect of phosphorus rate and placement on plant establishment (21 June) and grain yield of lentils and lupins at Barellan in 2021.*

Treatment	Lentils		Lupins*	
	Establishment (plants/m^2)	Yield (t/ha)	Establishment (plants/m^2)	Yield (t/ha)
Phosphorus rate (kg/ha)				
0	86	2.79	31	1.74
11	88	3.17	28	1.81
22	84	3.55	25	1.90
l.s.d. (*P*<0.05)	n.s.	0.32	4.4	n.s.
Placement				
With Seed	82	3.25	25	1.82
IBS	91	3.09	31	1.82
l.s.d. (*P*<0.05)	8	0.11	3.5	n.s.

* Lupin growth was limited by hares, affecting biomass and yield. No comparison can be made between lentils and lupins.

Gol Gol site attributes

2021

Soil chemical characteristics

Sampled 30 May

Characteristic	Unit	Soil depth (cm)				
		0–10	10–30	30–60	60–90	90–120
pH ($CaCl_2$)		7.72	8.11	8.21	8.41	8.47
Organic Carbon	%	0.64				
Phosphorus (Colwell)	mg/kg	21				
Potassium (Colwell)	mg/kg	514				
Nitrate N	mg/kg	19	3.1	2.7	3.5	3.1
Ammonium N	mg/kg	<1	<1	<1	<1	<1
Conductivity	dS/m	0.13	0.11	0.15	0.32	0.43
Cation Exchange Capacity	meq/100g	15.8				
Exchangeable calcium	%	81.2				
Exchangeable magnesium	%	10.2				
Exchangeable potassium	%	8.3				
Exchangeable sodium	%	0.3				
Exchangeable aluminium	%	0.0				

Crop sequence and key management dates

Crop sequence	
Year	Crop
2020	Fallow
2019	Wheat

Site management		
Activity	Date	Comments
Sowing	31 May	All crop types
Harvest	11 November	Lentils, field peas
	1 December	Chickpeas, faba beans

Seasonal conditions

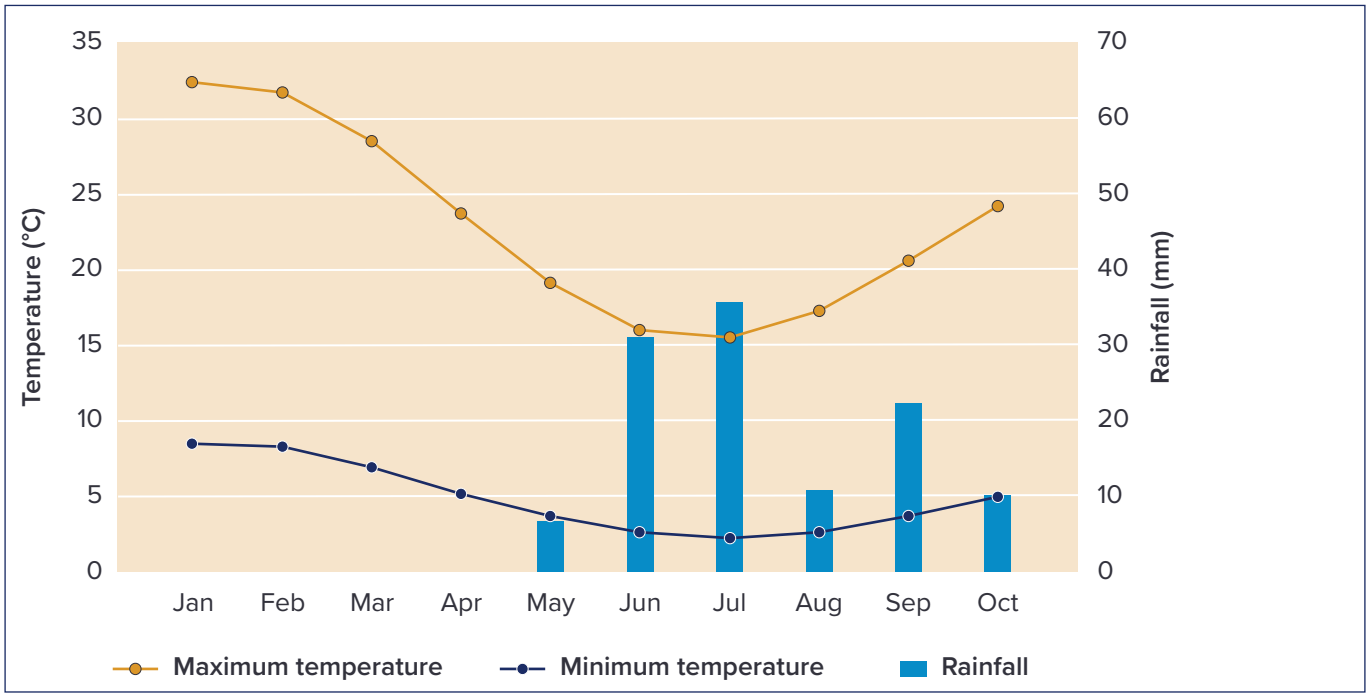


Figure 32: *Rainfall and temperature data for Gol Gol in 2021.*

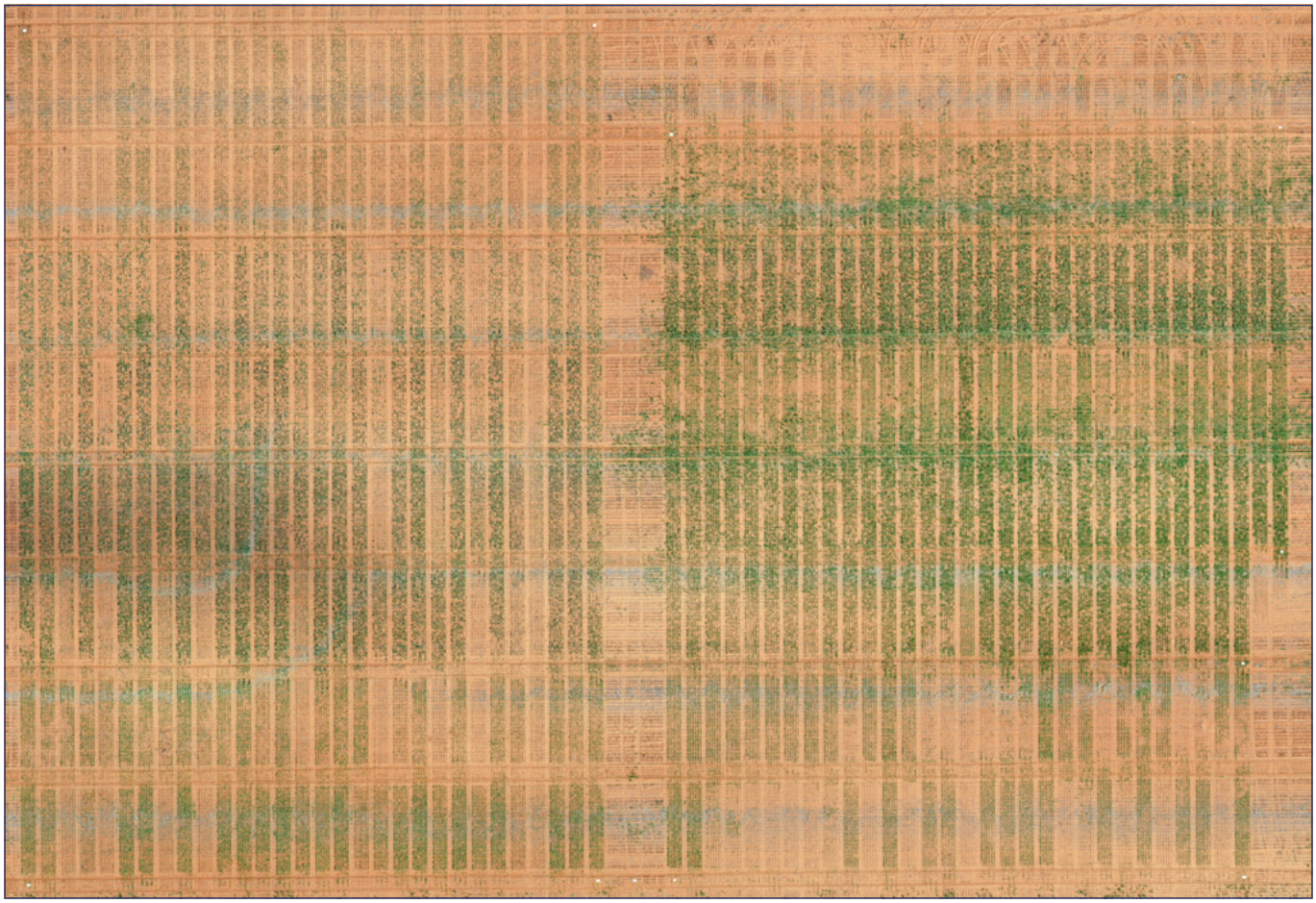


Figure 33: *Transparent mosaic, aerial view of the trial site at Gol Gol in 2021.*

Group 2 herbicide tolerant pulse crops

Gol Gol 2021

Key Findings

- Grain yields of all species (lentil, field pea, faba bean and chickpea) at this site were very low and generally less than 0.5 t/ha. Seasonal conditions were very dry during autumn and winter before favourable spring growing conditions (rainfall and relatively cool maximum temperature during September and October) provided for some yield recovery.
- Triasulfuron (e.g. Logran, sulfonylurea herbicide Group 2) residues and the in-crop application of Intercept® (imazamox + imazapyr, an imidazoline herbicide Group 2) resulted in total crop failure in the conventional (non-herbicide tolerant) varieties of all four species.
- The presence of Intercept® residue did not affect the grain yield of the conventional field pea variety (PBA Wharton$^{\phi}$) or conventional faba bean variety (PBA Samira$^{\phi}$). However, Intercept® residues completely killed the conventional lentil variety PBA Bolt$^{\phi}$ and reduced yield by two-thirds in the conventional chickpea variety CBA Captain$^{\phi}$.
- PBA Highland XT$^{\phi}$ (imidazolinone tolerant) showed good tolerance to Group 2 herbicide treatments, including where triasulfuron residues were simulated.
- Triasulfuron residues suppressed the yield of the imidazolinone tolerant faba bean (PBA Bendoc$^{\phi}$), field pea (GIA2005P) and chickpea (D16218). However, yield was not affected by the post-emergent application of Intercept® and Broadstrike®.
- Always read and follow product label thoroughly.

Figure 34: *Group 2 herbicide tolerance pulse trial at Gol Gol in2021.*

Trial Details

Table 38: *Sowing date, starter fertiliser and treatments (pre- and post-emergent herbicides and simulated Group 2 residue) applied to lentil, field pea, faba bean and chickpea trials at Gol Gol in 2021.*

Management		
Sowing date	Sown into marginal moisture conditions on 31 May	
Starter fertiliser	50 kg/ha Granulock Z (11% nitrogen, 21.8% phosphorus, 4% sulphur, 1% zinc)	
Species	**Variety – conventional**	**Variety – imidazolinone tolerant**
Lentils	PBA Bolt(ф)	PBA Highland XT(ф)
Field peas	PBA Wharton(ф)	GIA2005P
Faba beans	PBA Samira(ф)	PBA Bendoc(ф)
Chickpeas	CBA Captain(ф)	D16218
Herbicide treatments		
Pre-emergent herbicide	**Simulated Group 2 residue***	**Group 2 post-emergent herbicide**
Nil	Nil	Nil
Diuron 550 g/ha+ Trifluralin 1.25 L/ha	Nil	Nil
Diuron 550 g/ha+ Trifluralin 1.25 L/ha	Nil	Broadstrike® 25 g/ha
Diuron 550 g/ha+ Trifluralin 1.25 L/ha	Nil	Intercept® 750 ml/ha
Diuron 550 g/ha+ Trifluralin 1.25 L/ha	Intercept® 750 mL/ha	Nil
Diuron 550 g/ha+ Trifluralin 1.25 L/ha	Triasulfuron 35 g/ha	Nil

* Treatments applied pre-sowing and incorporated by sowing.
Note: diuron 900 g/kg; trifluralin 480 g/L; triasulfuron 750 g/kg; Intercept® = 33 g/L Imazamox + 15 g/L Imazapyr; Broadstrike® = 800 g/kg flumetsulam.

Results

Grain yield

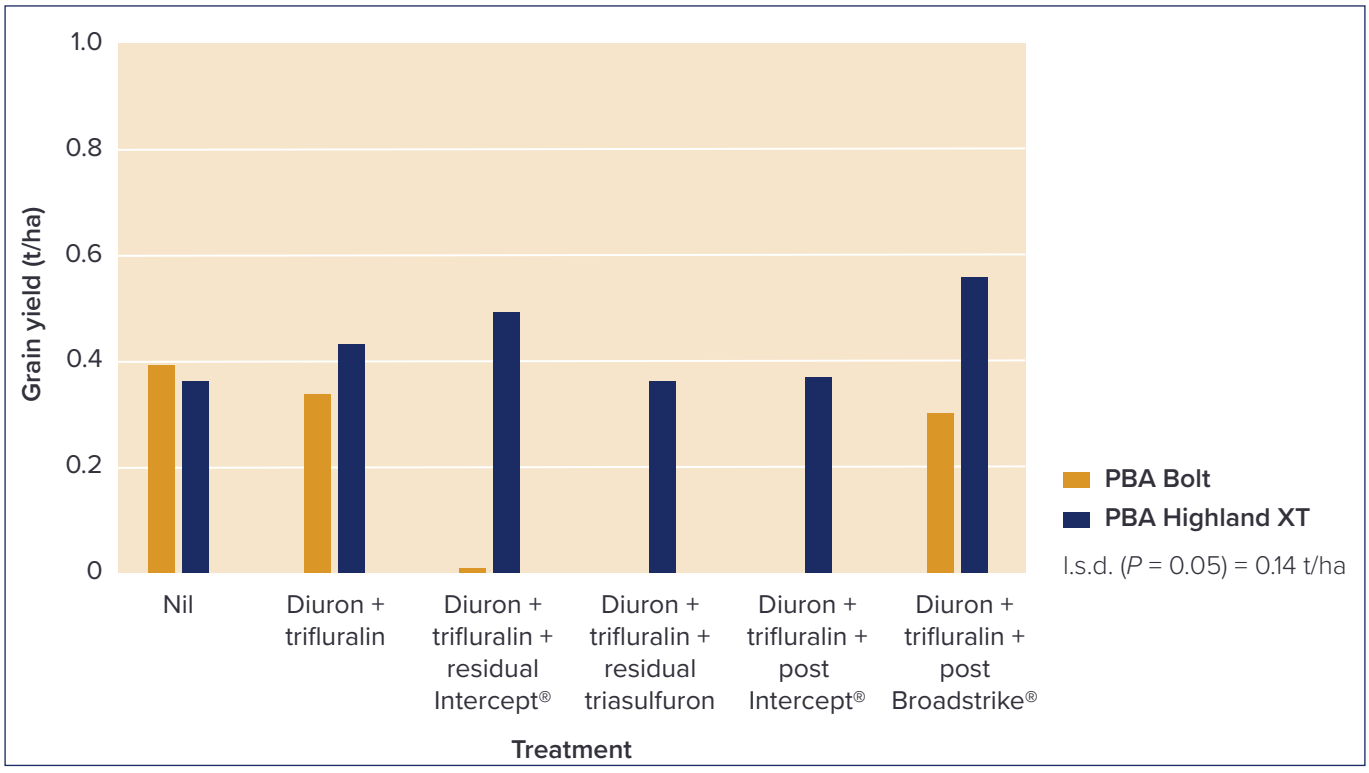


Figure 35: *Grain yield of conventional (PBA Bolt(ф)) and Group 2 imidazolinone tolerant (PBA Highland XT(ф)) lentil varieties in response to herbicide treatment at Gol Gol in 2021.*

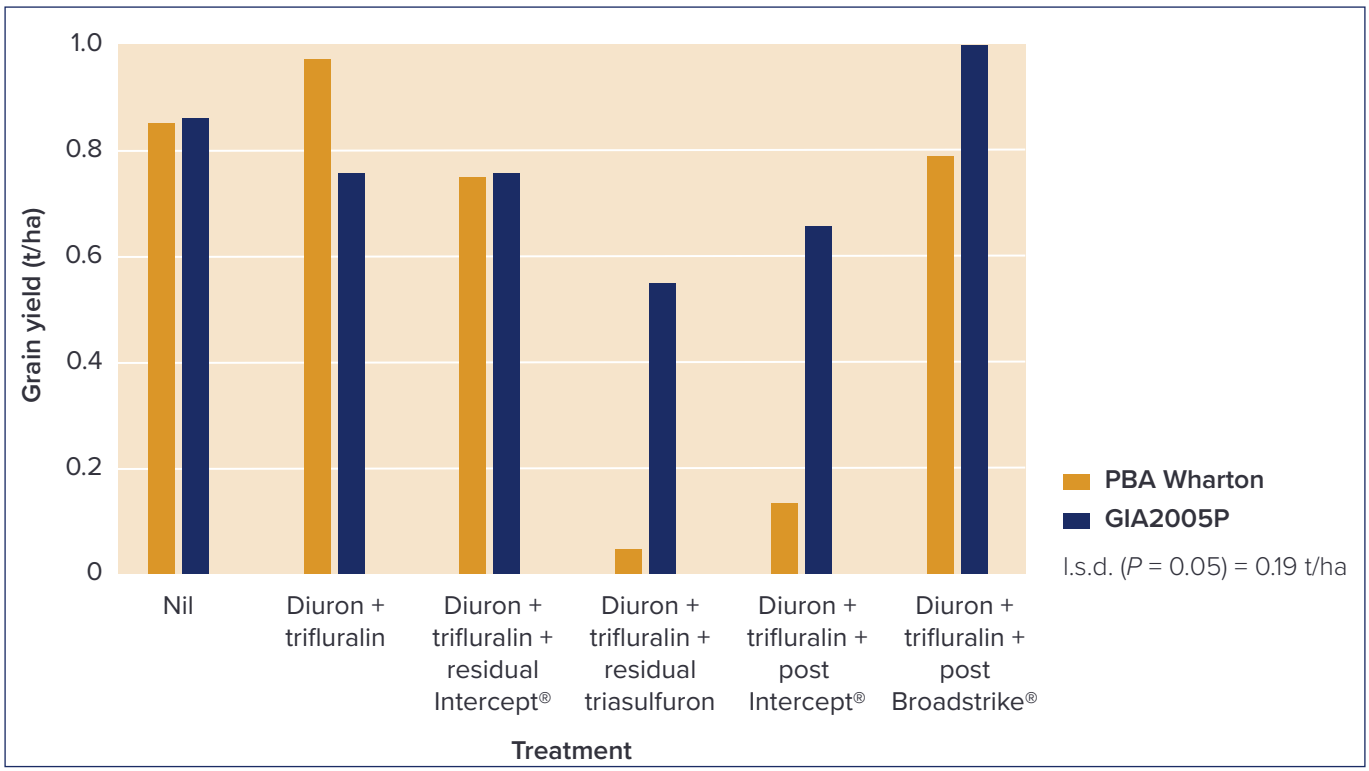


Figure 36: *Grain yield of conventional (PBA Wharton(ϕ)) and Group 2 imidazolinone tolerant (GIA2005P) field pea varieties in response to herbicide treatment at Gol Gol in 2021.*

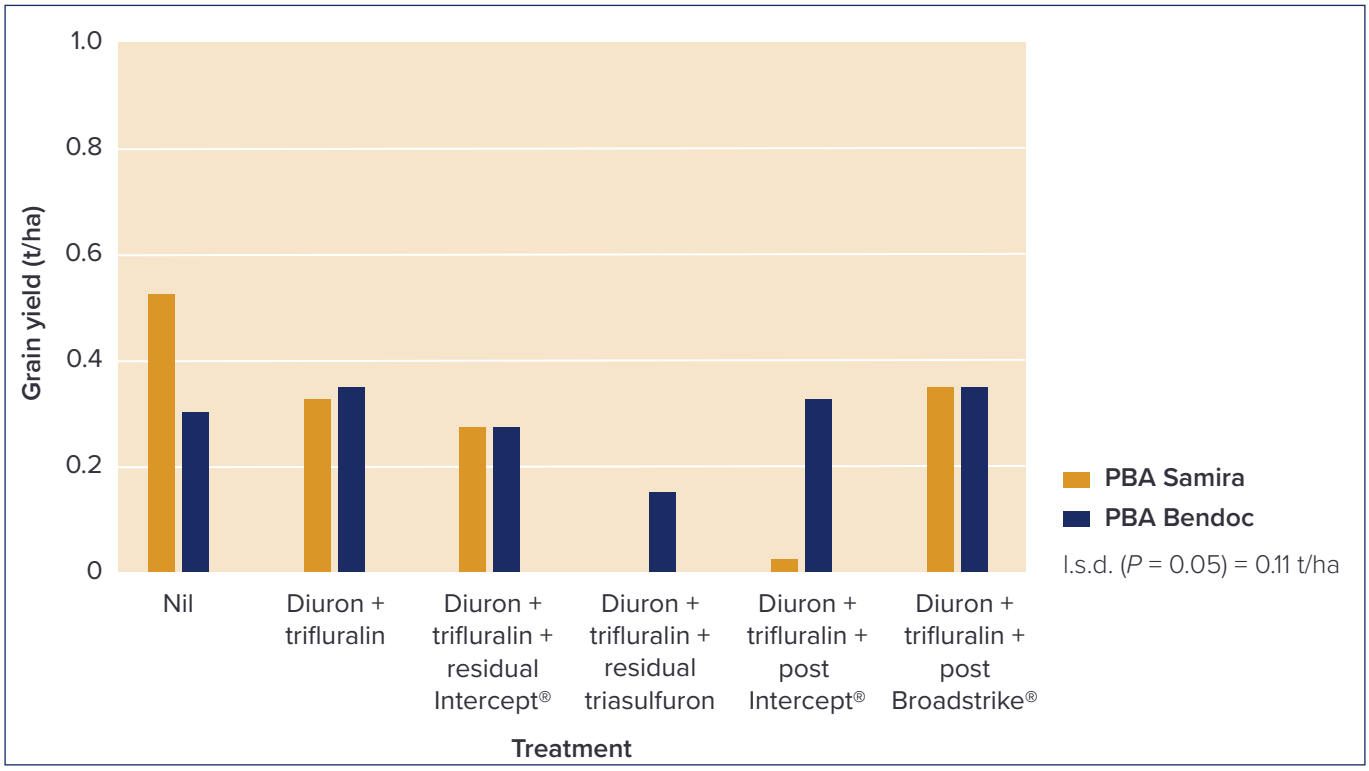


Figure 37: *Grain yield of conventional (PBA Samira) and Group 2 Imidazolinone tolerant (PBA Bendoc) faba bean varieties in response to herbicide treatment at Gol Gol in 2021.*

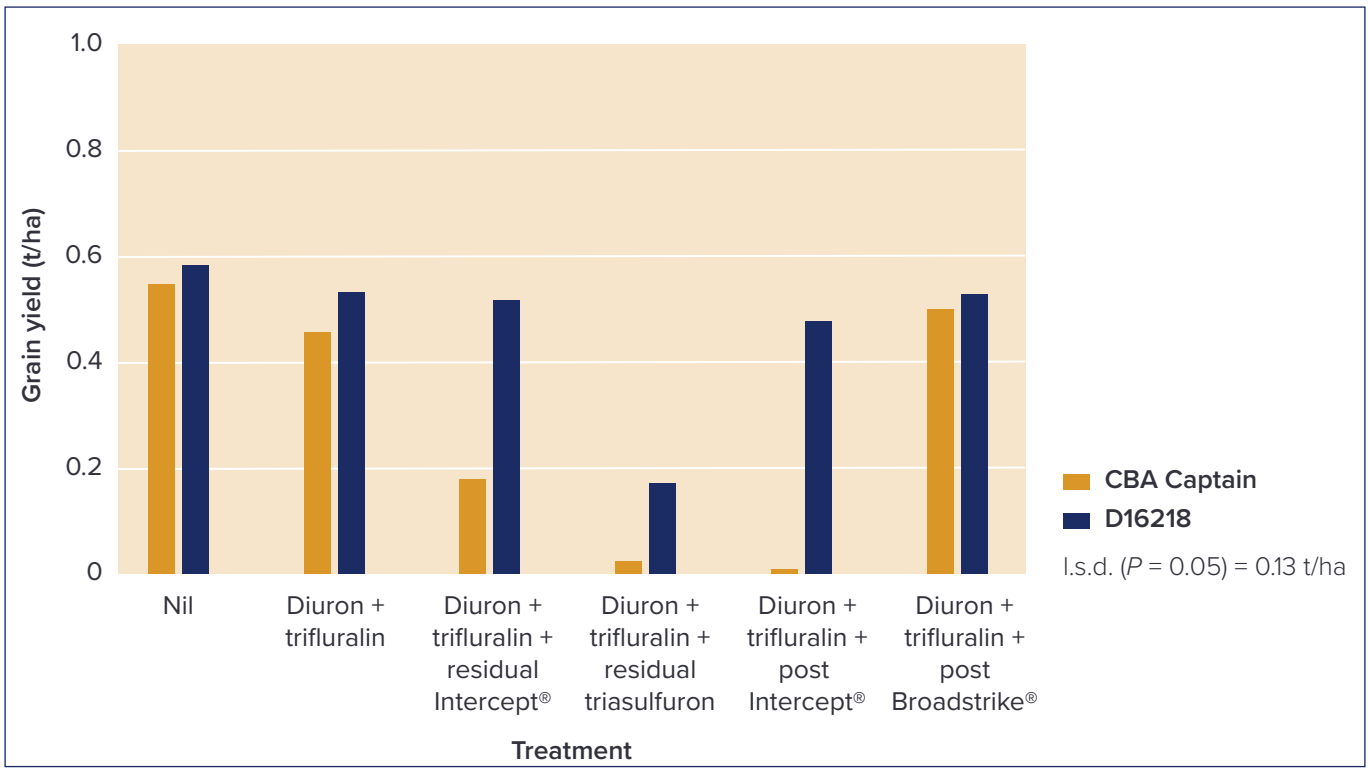


Figure 38: *Grain yield of conventional (CBA Captain) and Group 2 Imidazolinone tolerant (D16218) chickpea varieties in response to herbicide treatment at Gol Gol in 2021.*

Metribuzin tolerant lentils

Gol Gol 2021

Key Findings

- Lentil grain yields at this site were very low and generally less than 0.5 t/ha. Seasonal conditions were very dry during autumn and winter before favourable spring growing conditions (rainfall and relatively cool maximum temperature during September and October) provided for some yield recovery.
- Despite low rainfall, all herbicide treatments damaged PBA Highland XT$^{\phi}$ (Group 2 imidazolinone tolerant) and reduced yield. Damage was exacerbated by sowing into a dry seedbed which allowed metribuzin (Group 5, trizainone herbicide) to quickly wash into the crop root zone on the break of the season.
- The grain yield of the metribuzin (and imidazolinone) tolerant variety GIA 2004 L was relatively consistent across all treatments (average 0.4 t/ha). In contrast the grain yield of PBA Highland XT$^{\phi}$ declined from 0.79 t/ha where no herbicides were applied to 0.1 to 0.2 t/ha where metribuzin was applied in crop.
- In the absence of herbicide damage, there was a large penalty for growing GIA 2004L in place of the current commercial variety PBA Highland XT$^{\phi}$. Therefore, to replace the current variety with the metribuzin tolerant variety, growers would need to be confident that there was a high risk of herbicide damage or significant benefits to be achieved by using metribuzin at higher than current rates.
- Post-emergent applications of metribuzin are currently not on label and have only been used in this trial to demonstrate the tolerance range of GIA 2004L. Always read and follow product label thoroughly.

Trial details

Table 39: *Sowing date, starter fertiliser and varieties of lentils at Gol Gol in 2021.*

Management	
Sowing date	Sown into marginal moisture conditions on 31 May 2021
Starter fertiliser	50 kg/ha Granulock Z (11% nitrogen, 21.8% phosphorus, 4% sulphur, 1% zinc)
Variety	PBA Highland XT$^{\phi}$ (imidazolinone tolerant) and GIA 2004L (metribuzin tolerant)

Table 40: *Herbicide treatments applied to lentils at Gol Gol in 2021.*

Pre-emergent herbicide	Simulated Group 2 residue*	Group B post-emergent herbicide
Nil	Nil	Nil
Metribuzin 180 g/ha	Nil	Nil
Metribuzin 180 g/ha	Intercept® 750 ml/ha	Nil
Metribuzin 280 g/ha	Nil	Nil
Metribuzin 280 g/ha	Intercept® 750 ml/ha	Nil
Metribuzin 280 g/ha	Nil	Metribuzin 280 g/ha
Metribuzin 280 g/ha	Intercept® 750 ml/ha	Metribuzin 280 g/ha

* Treatments applied pre-sowing and incorporated by sowing.
Note: metribuzin 750 g/kg; Intercept® – 33 g/L Imazamox + 15 g/L Imazapyr

Results

Grain yield

Table 41: *Grain yield of commercial lentil variety (PBA Highland XT$^{\Phi}$) and metribuzin tolerant lentil variety (GIA 2004L) in response to metribuzin and imidazolinone herbicide treatments.*

Herbicide treatment	Grain yield (t/ha)	
	PBA Highland XT	GIA 2004L
Nil	0.79	0.37
Metribuzin 180 PSPE	0.32	0.51
Metribuzin 180 PSPE + Imidazolinone residue	0.46	0.37
Metribuzin 280 PSPE	0.32	0.45
Metribuzin 280 PSPE + Imi	0.13	0.46
Metribuzin 280 PSPE + 280 Post	0.15	0.42
Metribuzin 280 PSPE + 280 Post + Imidazolinone residue	0.10	0.45
l.s.d. (Variety x Herbicide) (P = 0.05)	0.18	

2021

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