2023 Trial Reports

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

GRDC GRAINS RESEARCH & DEVELOPMENT CORPORATION

THE UNIVERSITY of ADELAIDE

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SARDI SOUTH AUSTRALIAN RESEARCH AND DEVELOPMENT INSTITUTE

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Project Investment

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

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

CONTENTS

MILLICENT, SOUTH AUSTRALIA

Early season rainfall and multiple rainfall events over 10 mm in May allowed great early vigour on the broad bean trial site in 2023. Growers in the lower southeast run a fine line when establishing Aquadulce broad beans as sowing early (early May) creates canopy management issues later in the season, while sowing too late (mid-June) can create establishment difficulties with nutrient translocation and availability. Rainfall in June was the highest on record (236 mm), with many paddocks sustaining waterlogging and anaerobic growing conditions. Fortunately, the trial site avoided most soil water issues, and the mild temperatures continued to allow nutrient movement through the crop. The months from July to October were warmer and drier than average (Figure 1-Figure 2) which reduced the requirement for foliar fungicide application across the southeast. The stored soil water and warm conditions allowed for an extended flowering period from early September to late October. Because of the gentle conditions, limited treatment effects were observed across the disease, nutrition, and canopy trials. Yields ranged from 3.8-5.1 t/ha across the broad bean trials on the site.

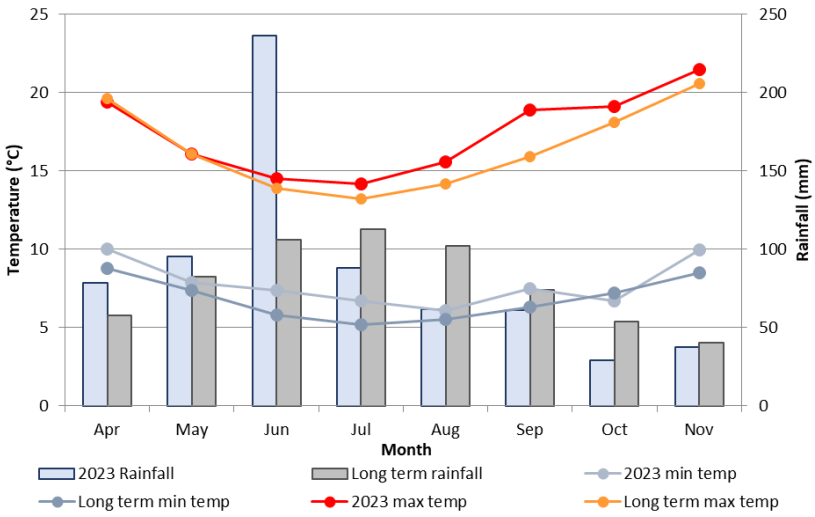

Figure 1. 2023 growing season and long-term rainfall recorded at Millicent (1877 to 2023) and long-term min and max temperatures recorded at Mount Gambier Aerodrome (1941 to 2023) for the growing season (April to November). Rainfall April to November = 689 mm.

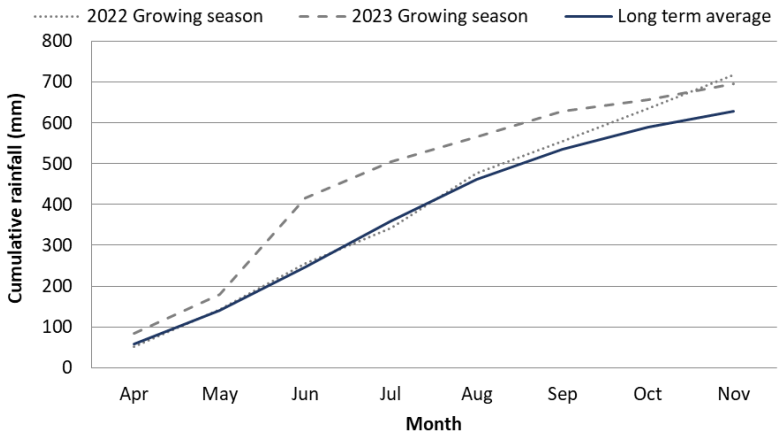

Figure 2. Cumulative growing season rainfall for 2022, 2023 and the long-term average for the growing season (April to November).

Table 1. Soil characterisation (Organosol) for Millicent trial site, 2023.

Depth	NH_3-N	NO_3-N	P	K	S	OC	EC	pH	pH
(cm)	(mg/kg)					(%)	(dS/m)	($CaCl_2$)	(H_20)
0-10	4.8	29.0	55	370	13	10.1	1.4	7.5	8.2

10-30	1.9	23.0	21	240	14	6.0	1.4	7.8	8.6	
Depth	**Cu**	**Fe**	**Mn**	**Zn**	**B**	**Exc Ca**	**Exc Mg**	**Exc K**	**Exc Na**	**Exc Al**
(cm)	(mg/kg)					(cmol(+)/kg)				
0-10	1.70	18.0	2.3	7.60	1.8	44.0	2.4	0.95	0.20	<0.1
10-30	0.65	10.0	0.7	2.60	1.4	36.0	2.1	0.63	0.32	<0.1

DISEASE MANAGEMENT STRATEGIES - PHYSIOLOGY, PATHOLOGY & AGRICHEMICALS COMBINED

Authors: Aaron Vague, Max Bloomfield, Daniel Bosveld, Rajdeep Sandhu

Aim: These trials aim to test the efficacy of different fungicide regimes based around plant phenology. Although we possess a reasonable amount of knowledge regarding the disease and the conditions conducive to infection in broad beans, our understanding of which specific parts of the plant should be prioritised for disease protection remains somewhat limited. Consequently, the central question that the fungicide trials aim to address is: "When is the optimal timing for fungicide application within the canopy to maximise yield returns?"

Treatments: Variety (cv. Aquadulce) x 8 fungicide treatments (Table 2) x 4 replicates = 32 plots

Table 2. Fungicide treatment list with development stage and product rates.

Treatment No.		**4 nodes – GS 104**	**1st Flowers open on main stem – BBCH 61**	**1st Flower (BBCH 65) + 14 - 21 days**	**1st Flower (BBCH 69) + 28 -42 days**
Date Applied		26 July	11 September	3 October	1 November
Active Ingredient		Tebuconazole 145mL/ha	Mancozeb 750 2.0L/ha + Procymidone 240g/ha (Nosclex 800 300g/ha)*	Chlorothalonil 2.3L/ha + Carbendazim 0.5L/ha	Chlorothalonil 2.3L/ha + Carbendazim 0.5L/ha
1.	Untreated	-	-	-	-
2.	1 F (Fungicide units)	-	-	-	+
3.	2 F (Fungicide units)	-	-	+	+
4.	3 F (Fungicide units)	-	+	+	+
5.	4 F (Fungicide units)	+	+	+	+
Active Ingredient		Tebuconazole 145mL/ha	Mancozeb 750 2.0L/ha + Procymidone 240g/ha (Nosclex 800 300g/ha)*	Miravis Star 1L/ha	Veritas 0.75L/ha
6.	1 F based on weather conditions from 1st flower + 14 days onwards	-	-	+	-
7.	2 F (Fungicide unit) – Expensive programme	-	-	+	+
8.	Complete Control (Expensive)	+	+	+	+

Table 3. Trial site details, Millicent 2023.

Trial design	RCBD
Data Analysis	Data was analysed using a one-way ANOVA in ARM.
Plot size	10 m x 4 m
Replicates	4
Sowing date	28 May 2023
Plant density	15 plants/m^2
Row spacing	36 cm

Fertiliser	110 kg/ha (10-17-0-12) (N-P-K-S)
Harvest date	16 January 2024

Key messages

- Low disease pressure in 2023 due to the drier spring produced grain yields of 3.81 to 4.19 t/ha.
- There were significant differences in total percentage of plot infection of chocolate spot (0.3 to 2.8% of canopy infected), but the untreated control with the highest amount of the disease was only infected in 2.8% of the plot.

Results and discussion

Plots were marked out in-crop in a paddock of Aquadulce broad beans sown by the grower on 28 May 2023. Plots were harvested on 16 January 2024.

Lower than average rainfall through the months of July-October limited the progression of Chocolate spot (CS, Botrytis fabae) in spring. Although temperature ranges were between the optimal range between 15-28 ˚C for Botrytis growth (Pulse Australia, 2021), the other pathological factor of canopy humidity during the critical reproductive phase was not conducive to high disease levels in the canopy. There were significant differences in total percentage of plot infection of chocolate spot (0.3 to 2.8% of canopy infected), but the untreated control with the highest amount of the disease was only infected in 2.8% of the plot (Figure 3). Rust was not observed.

A season with low levels of foliar disease produced grain yields of 3.81 to 4.19 t/ha, with no significant statistical differences among the eight treatments (Figure 4).

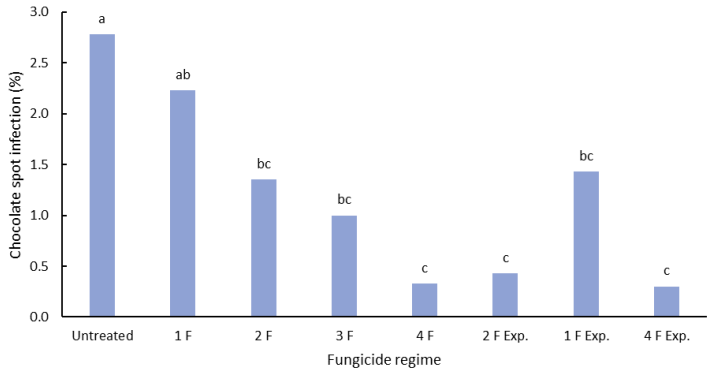

Figure 3. Broad bean chocolate spot (Botrytis fabae) infection (% of whole canopy) of eight fungicide regimes, measured 29 November 2023. Bars with different letters are significantly different (LSD (P < 0.05) = 1.3).

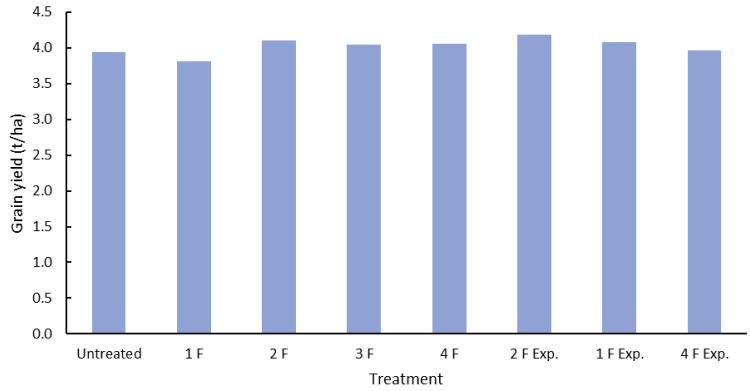

Figure 4. Grain yield (t/ha) of broad beans (cv. Aquadulce) across eight fungicide regimes measured 16 January 2024. No significant differences were observed.

STRATEGIC PHOSPHORUS AND IRON APPLICATIONS IN CALCAREOUS ORGANOSOLS

Authors: Aaron Vague, Max Bloomfield, Daniel Bosveld, Rajdeep Sandhu

Aim: This trial aims to compare the relative yields of different nutrition approaches on broad beans and the impact of crop nutrition prior to the onset of flowering. In high organic matter soils with a pH range from 7.5-7.8 in CaCl2, this trial focuses on interplay of additional phosphorus (P) early in the season and foliar iron (Fe) application in the spring.

Treatments: Variety (cv. Aquadulce) x 4 nutrition treatments x 4 replicates = 16 plots

The trial was managed throughout the season for disease with fungicide and balanced with macro- and micro-nutrients to elicit the desired treatment effects.

Table 4. Nutrition treatment list and product rates, Millicent 2023.

Trt No.	Description	Product
1.	Untreated	N/A
2.	50 P kg/ha (additional to sowing application)[1]	Single superphosphate (SSP)
3.	RapiSol Fe 2 kg/ha[2]	RapiSol Fe (EDTA 13.2 w/w%)
4.	50 P kg/ha (additional to sowing application)[1] + RapiSol Fe 2 kg/ha[2]	SSP + RapiSol Fe (EDTA 13.2 w/w%)

[1]Applied at sowing, [2]applied 12 September BBCH61.

Table 5. Trial site details, Millicent 2023.

Trial design	RCBD
Trial Design	Data was analysed using a one-way ANOVA in ARM.
Plot size	10 m x 4 m
Replicates	4
Sowing date	28 May 2023
Plant density	15 plants/m^2
Row spacing	36 cm
Fertiliser	110 kg/ha (10-17-0-12) (N-P-K-S)
Harvest date	16 January 2024

Key messages:

- Additional P and Fe gave no statistical difference in grain yields (3.99 to 4.29 t/ha).
- In-season Fe leaf tissue sampling provided inconclusive results to support application decisions.

Results and Discussion

Plots were marked out in-crop in a paddock of Aquadulce broad beans sown by the grower on 28 May 2023. Plots were harvested on 16 January 2024.

No measurable difference was observed in Fe tissue testing in the youngest open leaf between the untreated and the Fe applied treatment (Table 6). Both treatments measured 62 mg/kg Fe, which is within the estimated critical level of 50-300 mg/kg for most crop types (Vitosh et al., 1995). Although iron deficiency symptoms were visible in the winter months (yellow plants, Figure 5), the broad beans showed signs of recovery (plants became green again, Figure 6) as conditions became warmer. This was to be the case in the 2023 season with the drier and warmer than average conditions through the reproductive phase in September and October.

Table 6. Youngest open leaf Iron tissue test (mg/kg) measured 13 Oct.

Treatment	Iron (mg/kg)
Untreated	62.0
RapiSol Fe 2 kg/ha (EDTA 13.2 w/w%)[2]	62.0

[2]Applied 12 September BBCH61

Figure 5. Early season iron deficiency in a broad bean plant.

Figure 6. Nutrition trial plots showing no visual symptoms of iron deficiency in late October.

There was no measurable difference in yield components at harvest (Table 7).

The trial was harvested on 16 Jan 2024 with no statistical difference in grain yield or seed size (Table 8).

Although seasonal conditions in June were wetter than average, the soil conditions in the trial area remained aerobic and the lack of differences in yield and yield components suggest availability of P to the plant was sufficient with the baseline untreated throughout the season. As the conditions were drier and warmer than average during the reproductive phase in spring, there was sufficient movement of Fe in the plant to not require additional foliar application at the beginning of flowering.

Table 7. Yield component measurements (branch number, pods/branch, pods/m2, plant height) measured 16 January 2024.

Treatment		Branch no. (branches/m²)		Pods/branch		Pods/m²		Plant height (cm)		Harvest DM (t/ha)	
1.	Untreated	39.4	-	5.2	-	210.0	-	138.5	-	13.5	-
2.	50P	34.6	-	5.4	-	188.2	-	136.2	-	16.5	-
3.	Fe (EDTA)	45.2	-	5.4	-	238.8	-	142.8	-	20.9	-
4.	50P + Fe (EDTA)	36.3	-	5.6	-	203.1	-	139.5	-	16.8	-
Mean		38.9		5.4		210.0		139.2		16.9	
LSD (P value=0.05)		*ns*		*ns*		*ns*		*ns*		*ns*	
P value		0.291		0.947		0.420		0.096		0.130	
CV		19.9		16.6		19.8		2.3		22.3	

Table 8. Grain yield (t/ha) and 1000 seed weight (g) measured 16 January 2024.

Treatment		Grain yield		1000 seed weight	
		t/ha		g	
1.	Untreated	4.16	-	1400.9	-
2.	50P	3.99	-	1414.2	-
3.	Fe (EDTA)	4.12	-	1385.2	-
4.	50P + Fe (EDTA)	4.29	-	1388.5	-
Mean		4.15		1397.2	
LSD (P value=0.05)		*ns*		*ns*	
P value		0.810		0.605	
CV		9.49		2.4	