Optimising
Irrigated Grains

FABA BEANS

GOOD MANAGEMENT GUIDELINES for Irrigated Crops:

2020 to 2022

SOWING THE SEED FOR A BRIGHTER FUTURE

Introduction

Good management guidelines for irrigated faba beans

This good management guidelines summary for faba beans has been taken from the results of the Optimising Irrigated Grain (OIG) research project, a GRDC investment conducted in south-east Australia ((FAR1906-003RTX) from 2019-23. The guidelines are laid out as key points with a small amount of supporting data taken from the trials conducted over these three years. ***Please note these guidelines only cover agronomy topics that were researched during the project (2020 – 2022), it is not intended to be a complete guide to growing irrigated crops. Instead, it carries key points noted to be instrumental in growing productive and profitable irrigated crops.*** These guidelines can be supplemented by reading the *Good Management Guidelines for Irrigated Crops* produced as a result of the project.

What did we do in the GRDC Optimising Irrigated Grains project?

This GRDC investment Optimising Irrigated Grains (OIG) (FAR1906-003RTX) was set up to identify gaps in our knowledge regarding the true economically attainable yield potential of winter and summer crops grown in south-eastern Australian irrigated farming systems. The focus was on crops where there was less knowledge of upper end yield potential, particularly in light of newer germplasm, management advances and innovations in soil amelioration.

The field research team (FAR Australia and Irrigated Cropping Council (ICC)) was charged with conducting over 60 individual trials per annum, in six crops, over a three-year research period (2020 – 2022). To conduct such a large number of trials, field experiments were consolidated into two major Irrigated Research Centres (IRCs) based at Kerang in Victoria and Finley in southern NSW. Most trials focussed on crop agronomy and were conducted on a grey clay soil at Kerang using predominately surface irrigation (flood), and at Finley on a red duplex using overhead and surface irrigation in collaboration with Southern Growers, NSW DPI and the Maize Association of Australia. Three satellite sites carried a smaller number of trials in the north midlands of Tasmania, south-eastern Australia and Griffiths in NSW in collaboration with Irrigation Research and Extension Committee (IREC), Riverine Plains Inc, Southern Farming Systems, South Australian Research and Development Institute (SARDI) and MacKillop Farm Management Group.

The research programmes were uniquely developed to evaluate crop specific agronomic management practices in irrigated environments in order to ascertain their effects on system productivity and profitability.

Crop specific agronomic practices were focussed on maximising system profitability through:

1. Understanding the yield potential of irrigated crops in the principal environments where research was taking place.
2. Understanding how to consistently optimise yield for the crops where gaps in knowledge were most apparent.
3. Optimising the return on nitrogen through improved nitrogen use efficiency (grain maize, canola, barley and durum).

ACKNOWLEDGEMENTS

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In addition, we would like to acknowledge the collaborative support of our principal trials research partner Irrigated Cropping Council (ICC). We would also like to acknowledge all the OIG partners and collaborators in the project, University of Tasmania, Southern Growers, NSW DPI and the Maize Association of Australia, Irrigation Research and Extension Committee (IREC), Riverine Plains Inc, Southern Farming Systems, South Australian Research and Development Institute (SARDI) and MacKillop Farm Management Group.

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Crop structure and Plant population

Key point summary

- ***High yielding faba bean crops greater than 7t/ha are achievable under both overhead and surface irrigation systems.***
- ***The penalty for growing faba bean crops that are too thin is significant under irrigation.***
- ***Aiming for populations above the optimum is less risky, with little to no penalty for canopies that are above optimum.***
- ***Despite slower sowing speeds, the profitability of higher seed rates was still advantageous.***
- ***With plot yields varying from 2.5t/ha to 8t/ha, the older variety Fiesta VF consistently out yielded the newer variety PBA Amberley by 8%.***
- ***Surface irrigation combined with growing season rainfall at both Finley and Kerang was at least 500mm in order to achieve 7t/ha plus.***
- ***Overhead irrigation systems in 2020 associated with 400mm of GSR and irrigation combined produced only 4-5t/ha with lower pod numbers/m^2 and harvest dry matter.***
- ***With a very wet spring and little or no need for irrigation in 2022 responses to disease control were the highest observed in the project.***
- ***However other than the extreme conditions of 2022 disease control responses in irrigated crops have not typically been as high as those observed in the high rainfalls further south.***

Cultivar and Population

Fiesta out yielded PBA Amberley by 8% across the two years of research trials when irrigation was required. This increased yield was consistent over plant populations that varied from low to high density, however at the high populations (plus 40 plants/m^2) PBA Amberley appeared to drop in yield slightly.

Irrigated grain yield plateaued at around 30 plants/m^2 and there was little gained going above 25 plants/m^2. However, when plant populations started to drop below 20 plants/m^2 the yield loss was significant. With higher yield potentials under irrigated cropping systems, the small drops in plant populations have a "magnifying" effect on grain yield loss (loss of approx. 1.5t/ha when dropping from 20 to 10 plants/m^2). In contrast, moving from 20-30 plants/m^2 increased yield by 0.5t/ha and whilst higher populations were rarely higher yielding, the risk of poorer yield performance was very slight in comparison to populations dropping below the optimum.

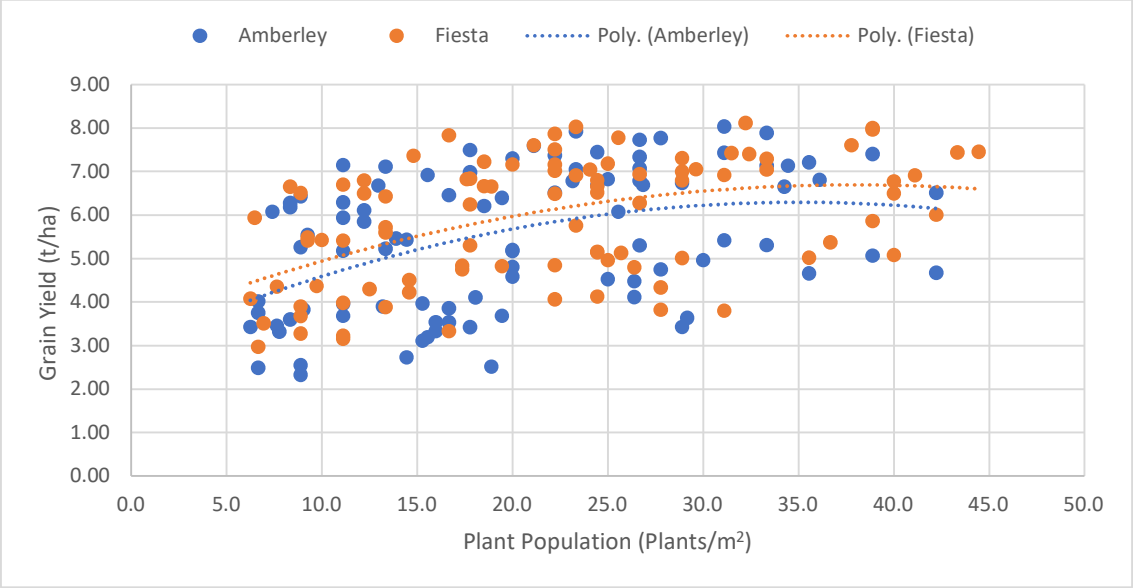


Figure 1. *The influence of faba bean plant populations on grain yield (t/ha). Data points from six trials across two years (2020 & 2022) and two sites (Finley and Kerang).*

If aiming for 20 plants/m^2, there are greater negative consequences if populations fall below that target than where populations are higher than the target, even up to 35-40 plants/m^2. Therefore, there is less risk of losing yield if aiming for higher populations (25-30 plants/m^2) than falling short.

Economics of higher seed rates

12 trials tested faba bean seed rates and plant populations over the three years of the project. These trials covered two sites, two cultivars, two irrigation types and 4 seed rates (plant populations) each year. The average yield for each seed rate across all these trials is shown in the table below. Yield increases with increasing seed rate even up to the maximum tested of 48 seeds/m^2, but growers need to know if it is economically feasible to increase seed rates. Apart from the cost of extra seed, one of the issues with increased seed rates is the ability of the seeding equipment to handle higher seed rates. The seed rates (seeds/m^2) below have been converted into sowing rate (kg/ha) based on an average seed size of 580g/1000seeds. A conservative estimate has been made that a seeder can sow up to 100kg/ha effectively, and for sowing rates above this one would need to slow down proportionally as seed rate increases. Effectively, sowing at 200kg/ha will be half the normal work rate and subsequently the contractor fee per hectare has been doubled. Using a combination of contract seeding fees and seed costs, the net income has been calculated for each seed rate.

Table 1. Influence of faba bean seed rate and plant population on yield (t/ha) and economics ($/ha).

Seed Rate	**12 seeds/m^2**	**24 seeds/m^2**	**36 seeds/m^2**	**48 seeds/m^2**
Seed rate (kg/ha)	70	140	210	280
Yield (t/ha)	3.4	4.4	4.8	5.0
Seed Price @ $500/t	$ 35.00	$ 70.00	$ 105.00	$ 140.00
Gross income @ $370/t	$ 1,273.67	$ 1,626.25	$ 1,776.41	$ 1,837.41
Contract rate ($/ha)	$ 60.00	$ 84.00	$ 126.00	$ 168.00
Total Seeding Costs	$ 95.00	$ 154.00	$ 231.00	$ 308.00
Net Income	**$ 1,178.67**	**$ 1,472.25**	**$ 1,545.41**	**$ 1,529.41**

Using a combination of contract seeding fees and seed costs, the margin over input cost has been calculated for each seed rate and compared to the standard seed rate of 12 seeds/m^2.

Table 2. *Return on investment (ROI) ($/ha, %) from incremental increases in faba bean plant populations.*

Seed Rate	12 seeds/m²	24 seeds/m²	36 seeds/m²	48 seeds/m²
Extra cost cf. 12 seed/m²	$ -	$ 59.00	$ 136.00	$ 213.00
Extra income cf. 12 seed/m²	$ -	$ 352.58	$ 502.74	$ 563.74
Net margin	$ -	$ 293.58	$ 366.74	$ 350.74
ROI		**498%**	**270%**	**165%**

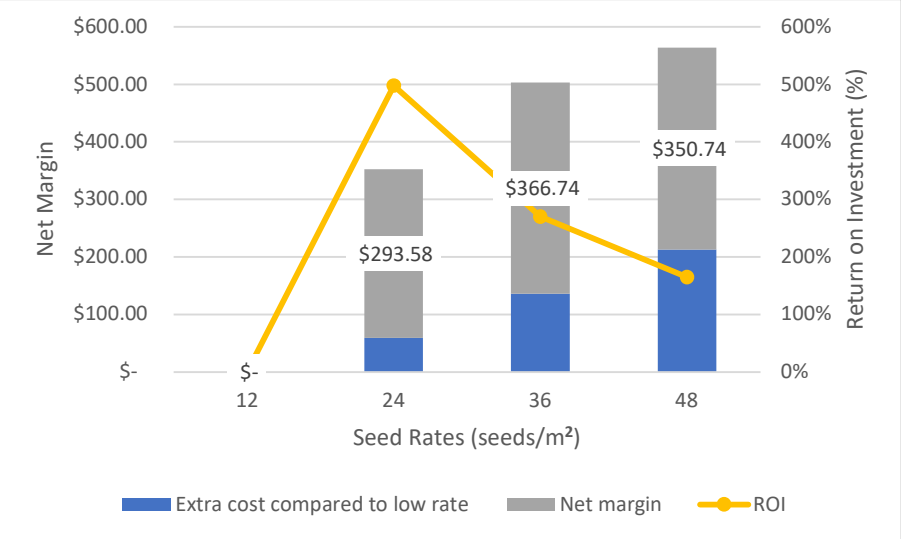
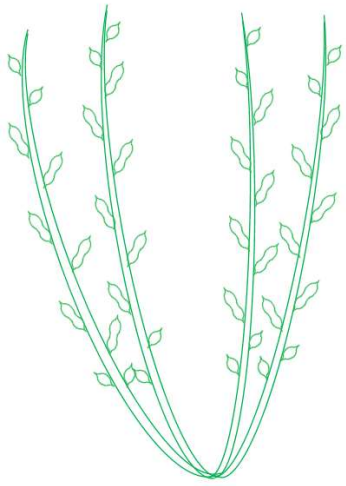


Figure 2. *Extra input costs, net margin ($/ha) and return on investment (ROI) of higher seed rates, compared to 12 seeds/m² (set at $0 for comparison purposes).*

What makes a 7-tonne faba bean crop?

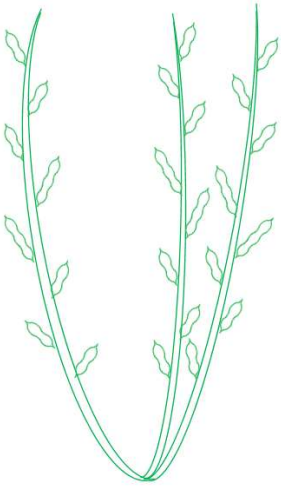
This illustration has been based on analysis of faba bean crops in the OIG project yielding over 7t/ha compared to crops with lower yields to illustrate where additional yield comes from.

Thin Canopy
12 Plants/m²



Thin	Yield Component	Thick
4.3 -	Stems/plant	2.7 -
9.5 -	Pods/stem	7.9 -
492 -	Pods/m²	471 -
1.7 -	Seeds/pod	2.3 -
687 -	Tsw (g)	694 -
52 b	**Stems/m²**	**60 a**
840 b	**Seeds/m²**	**1088 a**

Thick Canopy
22 Plants/m²



Nitrc

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5.8 t/ha

7.6 t/ha

- ***Using current estimates, high yielding faba bean crops are removing more nitrogen in the grain than they are supplying in nitrogen fixation.***

Current rules of thumb (for dryland bean crops) for nitrogen fixation are 20kg of N fixed per tonne of dry matter biomass at flowering and estimates of nitrogen removal are based on 40kg of N per tonne of grain.

Using these estimates, our irrigated faba bean crops are removing up to 300kg N/ha while only supplying 110-190kg N through fixation leaving a large N deficit.

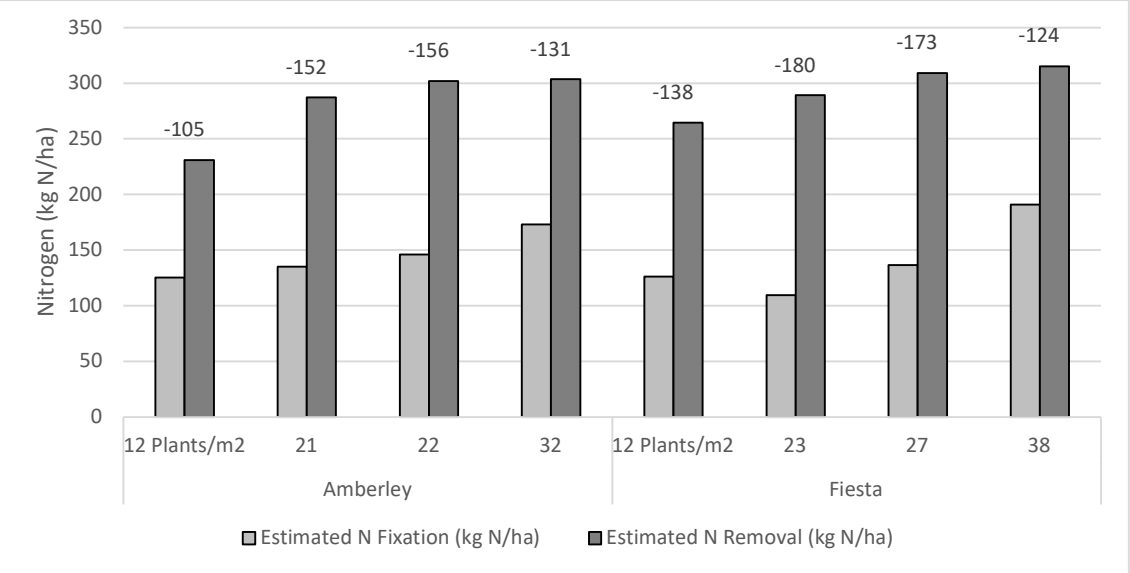

Figure 3. *Estimates of nitrogen fixation and removal from high yielding irrigated faba bean crops. Data labels show the nitrogen deficit.*

Disease management in faba beans

Key point summary

- ***Irrigated faba beans have not been as responsive to disease management as crops grown under high growing season rainfall conditions, illustrating that irrigation has not created the same conditions for infection as crops exposed to frequent rainfall events such as 2022.***
- ***Of the three years (2020 – 2022), evaluated disease as a result of chocolate spot caused by the pathogen Botrytis fabae was most problematic in 2022 when little or no irrigation was applied to the crop.***
- ***When the flowering and the early pod fill period are subject to wet weather (as opposed to irrigation under bright sunny drying conditions), greater persistence needs to be considered for fungicide inputs either by virtue of more fungicide applications, higher rates or more effective fungicides (SDHI based applications) such as Miravis® Star based on the SDHI pydiflumetofen or Aviator Xpro based on the SDHI bixafen).***

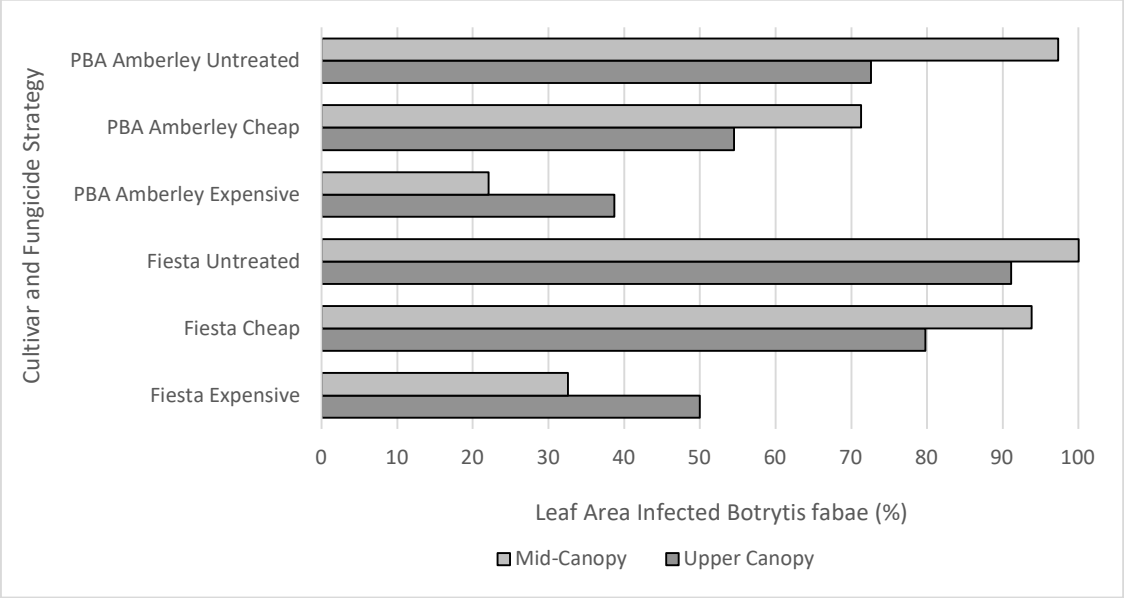

Figure 4. *Influence of fungicide strategy on chocolate infection severity during pod set in the mid and upper canopy – Finley, NSW 2022.*

Notes on fungicide application in 2022 are laid out.

Table 2. *2022 Fungicide treatments and timings on faba beans – Finley, NSW 2022.*

	Application Timing		
Planned	4-6 Node	Pre-Flower	Mid-Flower
Actual	8 Node (10 Aug)	Pre-Flower (26 Aug)	Mid-Flower to Early Pod Set (29 Sept)
	Treatment Product and Rate		
Untreated	-	-	-
Cheap	Tebuconazole 430 @ 145mL/ha	Chlorothalonil 720 @ 1.4L/ha	Chlorothalonil 720 @ 1.4L/ha
Expensive	Veritas @ 1L/ha	Aviator Xpro @ 600mL/ha	Veritas @ 1L/ha

Table 3. *Influence of fungicide strategy faba bean grain yield (t/ha) – Finley, NSW 2022.*

	Yield t/ha		
Fungicide Strategy	**PBA Amberley**	**Fiesta VF**	**Mean**
Untreated	2.45 cd	2.04 d	**2.25 c**
Cheap	2.62 cd	3.00 bc	**2.81 b**
Expensive	3.36 b	4.14 a	**3.75 a**
Mean	**2.81 -**	**3.06 -**	

Cultivar	**LSD p=0.05**	ns	**P val**	0.160
Fungicide Strategy	**LSD p=0.05**	0.41	**P val**	<0.001
Cultivar x Strategy	**LSD p=0.05**	0.58	**P val**	0.025

NOTES

CONTACT US

VICTORIA (HEAD OFFICE)
Shed 2/ 63 Holder Road,
Bannockburn, Victoria 3331
+61 3 5265 1290

NEW SOUTH WALES
12/ 95-103 Melbourne Street,
Mulwala, NSW 2647
+61 3 5744 0516

WESTERN AUSTRALIA
9 Currong Street
Esperance, WA 6450
0437 712 011

www.faraustralia.com.au

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