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GRDC
GRAINS RESEARCH & DEVELOPMENT CORPORATION

Growing Faba Beans

on the south coast of Western Australia

Growing faba beans on the south coast of Western Australia

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Cover Photo: Faba beans at Kojaneerup 2020

Cover Photo Credit: Carla Milazzo

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Foreword

Thirty-three years ago I started work in Esperance on broadleaf crops. One of the best things my boss set up for me was arranging visits with several lupin farmers so I could follow their crops from seeding, through the growing season, to harvest. It was a great way to quickly get an idea of the choices farmers make and the reasons why.

With today's busy lives, most farmers would be hard pressed to have the luxury of visiting many other farmers multiple times to learn how to grow a crop. Luckily for those who are interested in growing faba beans, our team of young and enthusiastic researchers from the regional agronomy project have done the hard work for you.

In this document that our team has put together, you will find a guide on how to grow and protect your faba bean crop plus several case studies on current faba bean growers in the south of Western Australia—all the key information you need is in one place. I started growing faba beans in trials 30 years ago and I'm still learning!

I'd like to congratulate our team on their efforts in pulling this document together and offer a special thank you to all the growers who allowed us to visit and passed on their experiences for us to share.

I encourage you to read through this document, whether you have grown faba beans for a while or are brand new to the crop. Growing a legume break crop is always a learning curve.

Mark Seymour
Senior Research Scientist

Department of Primary Industries and Regional Development (DPIRD) Esperance

Mark Seymour at
Kendenup, June 2019

Acknowledgments

In 2016 the Grains Research and Development Corporation (GRDC) and DPIRD invested in the 'Building crop protection and crop production agronomy R&D capacity in regional Western Australia' project (DAW00256/DAW1512-001RTX), also known as the regional agronomy project.

To address the industry-identified need to increase regional research and development (R&D) capacity, this project based a team of 10 early-career research agronomists across the four port zones in Western Australia. The team worked closely with growers, grower groups, and local agribusiness to address local R&D priorities by delivering activities such as workshops, trials, and demonstrations.

The regional agronomy teams based in Esperance (King Yin Lui, Emma Pearse) and Albany (Sarah Belli, Carla Milazzo, and Jeremy Lemon) identified an increasing interest in faba beans as a rotational break crop, particularly on the south coast. The team encountered many growers who have no experience with faba beans and are looking for tips on how to grow a successful crop.

Throughout 2020 the team surveyed and monitored 15 faba bean paddocks across the south coast, learning tips and tricks for successful faba bean production and collating this information. We sincerely thank the growers involved for sharing their experience and time.

This document also includes reviewed and updated information that was originally published in the Department of Agriculture and Food 2005 Bulletin 4645: *Producing pulses in the southern agricultural region*, written by Peter White, Mark Seymour, Pam Burgess, and Martin Harries. We acknowledge this previous work.

We would particularly like to thank Mark Seymour (DPIRD Esperance) for his support and insight in developing this document. Additional reviewing and editing of content by Jean Galloway, Carla Wilkinson, Jeremy Lemon, George Mwenda, Svetlana Micic, Stacey Power, Ben Curtis, Glen Riethmuller, Andrew Blake, Megan Abrahams and Peter Gartrell is greatly appreciated and acknowledged.

This project would not have been possible without the joint investment by GRDC and DPIRD in these projects:

- *Building crop protection and crop production agronomy R&D capacity in regional Western Australia* (GRDC DAW00256/DAW1512-001RTX)
- *Building crop protection and production agronomy R&D capacity in regional Western Australia.* (Royalties for Regions Boosting Grains R&D flagship project FFPjP13)

Finally thankyou to the team for an amazing job in compiling this comprehensive overview of faba bean production. It collates an enormous amount of work that will be invaluable reference for growers wishing to incorporate faba beans into their systems.

Vanessa Stewart
Project Manager, Manager Dryland Farming Systems

DPIRD Merredin

1. Why grow faba beans?

Legumes form symbiotic relationships with soil bacteria called rhizobia. Rhizobia form nodules on legume roots where atmospheric nitrogen (N) from soil pores is fixed into plant-available N and fed to plants. In return legumes feed rhizobia carbohydrates. After the legume dies, root nodules and plant residues break down and release N into the soil. N is a critical building block for plant protein.

There are many well understood reasons for growing legumes, such as:

- fixing nitrogen to increase soil fertility and reduce input requirements
- providing disease breaks in cereal–canola rotations
- increasing income source diversity
- increasing diversity of crop protection chemicals to reduce pressure on weeds, pests, and diseases developing pesticide resistance

This guide has been developed for the medium- to high-rainfall zone of southern Western Australia (WA) to encourage faba bean adoption. We believe faba beans are a particularly good fit for growers in this area who are looking for a legume that:

- fits into 100% cropping and mixed farming systems
- has a higher yield potential than other pulses
- fixes N for itself and subsequent crops
- can be sown early, dry, and to depth to chase moisture
- tolerates waterlogging better than other grain legumes
- has new varieties with more robust genetics with improved disease resistance or improved tolerance to imidazolinone (IMI) and other herbicides
- is a break crop for the root lesion nematode (RLN), *Pratylenchus neglectus.*
- can be sown and harvested using existing machinery and equipment used for cereals

In recent years, interest in growing faba beans has increased among grain growers across the south coast of WA. We believe the term ‘failure beans’, coined in the late 2000s, is no longer appropriate, with the availability of new varieties better suited to WA farming systems, greater adoption of soil amelioration practices, and better knowledge of the needs of legume crops.

To guide prospective growers, Section 12 of this document compiles the perspectives and experiences of 15 grain growers who produce faba beans.

2. Residual nitrogen value of faba beans

Jeremy Lemon, DPIRD Albany

Key points

- The value of residual N from faba beans is similar to other pulse crops
- The amount of residual N is proportional to total legume biomass minus the amount of N exported in grain
- The economic benefit will depend on the crop yield potential of the following crops, price of bagged N, and paddock N fertility (including soil and fertiliser N)

As a legume, well-nodulated faba beans have several benefits in crop rotation including residual N for subsequent crops. The main questions are: how much N is fixed, and when is it available for following crops? In common with N cycling from any legume, rainfall patterns, the potential yield of following crops and soil type all influence the amount of N available and the economic benefit. Accuracy in measurement and calculations are affected by paddock variability and seasonal uncertainty.

Calculating residual N

The N available to a crop following a faba bean year will depend on the total legume biomass produced minus the amount of N exported in grain. To avoid complex measurements and calculations, average values were incorporated into calculators or decision support tools. Numerous such tools are available; some commonly used tools include:

- Select Your Nitrogen (DPIRD)
- NUlogic (CSBP); available from: https://csbp-fertilisers.com.au/services/nutritional-management/nulogic-soil-analysis
- Yield Prophet (Birchip Cropping Group); available from: https://www.yieldprophet.com.au/yp/Home.aspx
- N Broadacre (Planfarm); available as an iPad app

Organic N in crop residue needs to be mineralised to plant-available ammonium and nitrate over summer and during the growing season. As biologically mediated processes, mineralisation requires water in the soil surface layer over a period of time; warm temperatures favour rapid mineralisation. In the first season after faba beans, the amount of N available to the crop varies around 40% (±10%) of the total N in residues.

A diminishing amount is available over subsequent seasons and by the third season only about 10% remains, which is only a small amount in the context of paddock supply and crop requirements.

Table 2.1: Amount of residual N (kg N/ha) available first year after a legume crop

Legume grain yield (t/ha)	Residual N (kg N/ha) first year after legume crop (grain yield relative to biomass)		
	High	Moderate	Low
0.5	20	24	33
1.0	32	40	55
1.5	42	53	80
2.0	55	67	105
3.0	80	100	155

Table 2.2: Amount of residual legume N (kg N/ha) for subsequent crops diminishes rapidly over seasons

Legume grain yield (t/ha)	Fixed N for subsequent crop (kg N/ha)		
	First season after legume crop	Second season after legume crop	Third season after legume crop
0.5	24	7.2	2.4
1.0	40	12	4
1.5	53	15.9	5.3
2.0	67	20.1	6.7
3.0	100	30	10

The values in this table are based on a moderate grain yield relative to plant growth

To gain most benefit from legume N, reduce fertiliser rates the following year by the estimated amount of legume residual N. Many growers do not account for legume N when fertilising cereal and canola crops. Growers risk over fertilising with excess N potentially leading to lower yields, higher screenings in cereals, and higher protein in some conditions. If your fertiliser N strategy after canola already achieves near yield potential, additional N from a legume crop will not increase yields—only protein levels will increase.

Too much nitrogen?

A comparison of barley yields after canola and faba bean at South Stirling (see Goad case study in Section 12) in 2019, which was a low-rainfall year, showed a barley yield (hand cut) of 6.9t/ha on the canola stubble with 10.7% protein and 5.8t/ha on faba bean stubble with 11.9% protein. Average barley yield of the paddock in the comparison areas (both canola and bean area) was 5.5t/ha. Both areas received the same rate of 85kg/ha fertiliser N. The additional N from beans decreased yield and grade because the paddock had high N nutrition from soil organic matter and fertiliser.

Tips for making the most of residual N

- Use a nitrogen decision support system that you are confident with and that accounts for legume yields relative to crop growth or total biomass
- Develop your own experience with crops on bean stubbles
- Base initial expectations on experience following other grain legumes and reduce fertiliser N rates according to estimates of available legume N, while matching crop requirement for N to updated yield targets during the season
- Nitrogen budgets can be supported with soil N testing close to sowing and in-season tissue testing
- Soil sampling in January will not account for the range of mineralisation possible during wet or dry autumn periods

King Yin Lui
at Gibson, 2020

3. Tips for successful crop establishment

King Yin Lui, DPIRD Esperance

Key points

- Earlier sowing and wider rows produce early biomass, with positive effects on grain size, early podding, and pod-set higher in the canopy, which improves yields. However, early sowing has negative implications for lodging and prolongs exposure to frost in high frost-risk areas
- Seeds can emerge from depth (>10cm), so deep sowing can be done to chase moisture in dry sowing conditions; however, dry sowing can reduce the efficacy of inoculants
- Rolling paddocks after seeding provides options for post-sowing pre-emergent (PSPE) herbicide application to manage in-furrow weeds

Choosing the right variety

The 2021 Western Australian Crop Sowing Guide (DPIRD; https://www.agric.wa.gov.au/2021-western-australian-crop-sowing-guide) contains the latest published data from national variety trials and summarised agronomy guides for pulses, including faba bean. The following subsections introduce the two newest faba bean varieties from Pulse Breeding Australia (PBA), PBA Bendoc and PBA Amberley.

PBA Bendoc

PBA Bendoc was released in 2018 as the first faba bean line with improved tolerance to imidazolinone (IMI) herbicides and the residues of some Group B herbicides including some sulfonylureas. Some registered herbicides containing imazomox and imazapyr (e.g. Intervix®)) have a minor use permit for use on IMI-tolerant faba bean varieties (Permit 86849) until 30 April 2022. This use is now also on the Intercept® label. PBA Bendoc has lower disease-resistance ratings for ascochyta and chocolate spot than PBA Samira, which is the most widely grown bean variety.

PBA Amberley

Released in 2019, PBA Amberley is a mid-season flowering faba bean with high yield potential in districts with higher rainfall and long growing seasons. It has a higher level of resistance to chocolate spot than all current varieties and is also resistant to ascochyta blight. The improved disease resistance of PBA Amberley offers the potential to reduce the risk and cost of faba bean production in high-rainfall areas where foliar fungal diseases are a major constraint. In limited trials in WA, PBA Amberley yields were comparable to PBA Samira.

Bulking up a new variety?

Faba beans are cross-pollinated, so the bulk-up area should be isolated from other varieties by at least 200m or genetic purity may be compromised. This is important for protecting traits for disease resistance or herbicide tolerance.

Handling seed and grain

Faba beans are prone to splitting and mechanical damage:

- Use belt conveyors or tubulators to minimise handling
- Use augers with large flight clearances at low speed and avoid dropping them from height onto hard surfaces
- Store seed at 10–14% moisture to prevent it becoming brittle

Sowing time

In general, faba beans are suited to early sowing (late April to mid-May) to maximise yield potential and promote early biomass, flowering and pod-set higher in the canopy. However, sowing too early increases the risk of lodging and necking, build-up of disease (primarily chocolate spot) increases frost risk and leaves less opportunity for pre-emergent weed control.

Late sowing generally reduces yield potential, exposing the crop to risk of temperature stress during flowering and podding and increasing budworm pressure on developing pods in spring.

Necking in high biomass crops

'Necking' is where the lower stem of the faba bean plant remains erect but a proportion of the stem bends/breaks or 'necks' over between 90 and 180 degrees in the podding zone or upper canopy.

Strong hot winds experienced across the Esperance port zone in 2020 resulted in necking in high biomass crops at early podding. At a farm in Grass Patch where two paddocks were sown at a similar time, the crop sown on sandy loam with good early biomass had widespread necking, compared to a neighbouring paddock on heavy clay soil and poor early vigour. Despite this, yield potential was higher in the sandy loam paddock with high biomass and more pods set per branch with pods set higher in the canopy.

Some varietal differences in lodging and necking tolerance were observed in variety trials across the Albany and Esperance port zones. Ratings are available in the variety and sowing guides, available from: https://www.agric.wa.gov.au/2021-western-australian-crop-sowing-guide.

Figure 3.1: Necking observed in Dalyup was widespread across the Esperance port zone in 2020.

Row spacing

The key drivers for wider row spacing (>25cm) are to promote better early pod-set and delay canopy closure, creating a paddock environment that is unfavourable for disease and forming part of an integrated disease management strategy.

Wider row spacing can cause weed issues by reducing crop competition and delaying canopy closure, yet also provides greater herbicide application options and pesticide coverage using hooded or shielded sprayers.

Wide rows in practice

After foliar disease made bean growing too risky in the 1990s dedicated faba bean grower, Mark Wandel, adopted a specialised 18m seeder bar and hooded sprayer. He sows on 75cm rows that allow him to use a hooded sprayer to apply broad spectrum herbicides in the inter-row to manage weeds in season.

He has been using his current system since 2003 and Mark reports improved foliar disease management from better fungicide and insecticide coverage.

Better varieties and agronomy has meant beans are now a reliable crop in the rotation. The wide rows help manage diseases early in the season by increasing airflow and delaying canopy closure, both of which create unfavourable conditions for disease. He also gets better fungicide coverage using the hooded sprayer on-row, which gives him confidence to spend more dollars per hectare on fungicide, with high water rates (100L/ha).

Many growers looking to wider row spacings sow 'skip rows' to avoid large capital outlay. Lloyd Burrell grows faba beans in West River. He uses 10-inch rows. However, he blocks off every third tine to reduce disease risk. He has also observed increased light penetration to the lower canopy of the plant, which helps increase early biomass and pod-set. See Section 12 for full details of each grower's methods.

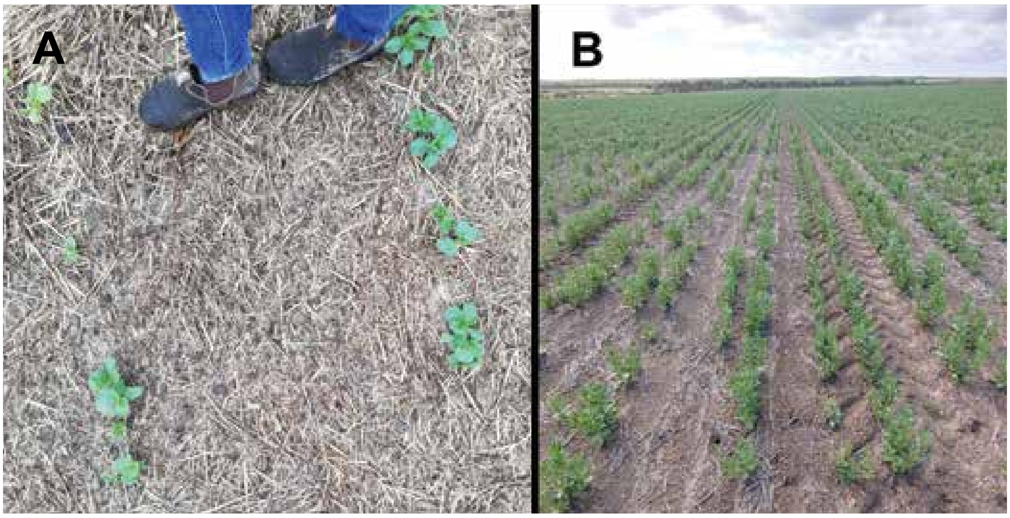

Figure 3.2: Wide rows in practice.

A. *Wide 75cm rows on a rolled paddock.* ***B.*** *Skip rows at every third row.*

Optimal plant density: Target seeding rates

Large variations in seed size and susceptibility to seed damage means that testing the germination percentage and calibrating seeding rates to your target desired plant density is particularly important.

Most growers on the south coast target a seeding rate of 100–150kg/ha, which results in a 10–20 plants/m^2 plant density. This is lower than the plant density recommended by the GRDC GrowNotes of 30 plants/m^2 (seeding rate of approximately 150–220kg/ha). However, there are discrepancies in research data as to the optimal plant density required for different rainfall zones and newer varieties, with evidence that there is little difference in dry matter biomass yield between plant density of 10–30 plants/m^2.

To calculate seeding rate, weigh 100 seeds to obtain seed weight (g), place the seeds in between wet paper towel or cotton wool to germinate and, after a few days, the number of seeds germinated will give you percent germination. A reasonable estimated field establishment rate is 90–95%, although it will be less if sowing into less than ideal conditions. Use this equation to calculate seeding rate:

$$\textbf{Seeding rate (kg/ha)} = \frac{\textit{(100 seed weight (g)} \times \textit{target plants/m}^2 \times \textit{1000)}}{\textit{(Germination \%} \times \textit{estimated establishment rate \%)}}$$

Reduced seeding rate and narrow rows (10 inch) for disease management

Rohan and Ruth Marold run a mixed cropping and livestock enterprise on the coast in Dalyup. They are in the high-rainfall zone where foliar disease can be a major issue. To reduce disease risk early in the season, they have opted to reduce their seeding rate to 80–90kg/ha instead of going to wider or skip rows. Reducing plant density has been shown to decrease chocolate spot severity, especially in high-risk seasons and growing areas.

See Section 12 for full details of their methods.

Sowing depth

Faba beans can be sown deep (5–15cm) without negatively affecting emergence. They have a hypogeal pattern of emergence, which means the cotyledons (seedling leaves) are below the soil surface allowing them to emerge from deeper in the soil. This contrasts with lupins and canola, which have an epigeal pattern of emergence where the cotyledon is above ground. Many faba bean growers on the WA south coast aim to sow faba beans to 10cm depth to chase moisture and achieve greater separation of the seed from pre-emergent herbicides especially in sandier soil types.

Rolling paddocks

Unlike lentils and field peas, faba beans do not have to be rolled, however, rolling after seeding can increase harvest efficiency for pods set low, especially in low-rainfall situations in low biomass crops, or if lodging or necking has occurred. Rolling can prevent pre-emergent herbicides from washing into furrows and increase the efficacy of herbicides applied PSPE, providing some in-furrow control in deep-sown crops. Broadleaf weed control is a major management issue when growing faba beans, because the beans are mostly sown early and rely almost solely on pre-emergent herbicides to manage weeds in season.

Further reading

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King Yin Lui at
Grass Patch, 2020

4. Inoculation

Grace Williams, DPIRD Merredin

Key points

- Inoculate every year with an appropriate rhizobia strain to maximise N fixation and faba bean yield
- Soil pH of at least 5.5 ($CaCl_2$), soil temperature below 30°C, and soil moisture at seeding will maximise root nodulation. Background nutrition and paddock rotation history may influence rhizobia abundance and efficacy. Soil moisture at seeding will maximise root nodulation
- Peat inoculants are reliable and cost-effective; however, granular products can provide better protection where rhizobia survival may be reduced eg. dry sowing
- Minimise exposure of rhizobia to heat, sunlight, and toxic substances as these reduce rhizobia survival
- Some fertilisers and seed dressings should be kept physically separate from rhizobia, including with inoculated seed in the seeder box and in the seeding furrow
- Assess nodulation when the crop is in the vegetative growth stage and look for pink or red nodules that are actively fixing N
- Poor nodulation may be a result of issues during inoculation or due to environmental factors such as high soil temperature, high soil N, or waterlogging

Effective inoculation is essential to getting the maximum N benefit possible from growing faba beans. Plants require N for growth and although it is abundant in the atmosphere (N_2), it is inaccessible to plants. Consequently, it needs to be converted (fixed) into biologically active forms such as ammonia. In a natural symbiotic process, rhizobia bacteria that live in the soil inoculate legume roots and form root nodules. Inside these nodules, the bacteria receive food and shelter from the plant and in exchange convert atmospheric N into ammonia.

Interactions between legumes and rhizobia are often highly specific and effective nodulation and maximum N fixation occurs only when the correct rhizobia strain for the host is present, the host plant is healthy, and growing conditions are favourable.

The rhizobia strain needed to colonise faba beans is not native to Australia and is introduced through inoculation using commercial rhizobia strains. Care is required throughout the inoculation and seeding process to prevent rhizobium death and ensure effective nodulation. Soil characteristics such as pH, moisture and nutrition, environmental conditions, and the inoculation process all affect nodulation and N fixation.

Inoculants

Inoculant types

Two strains of rhizobia that nodulate faba beans are produced commercially as inoculants. The strain WSM1455 (referred to as Group F) is produced for inoculating faba beans and lentils, while SU303 (referred to as Group E) is produced for field peas and vetch but will also colonise faba bean and can be used if Group F is not available. In recent years a combined product has been available (Group EF).

Inoculant can be purchased as a peat or granular formulation; however, liquid and freeze-dried inoculants are also available commercially. Peat is applied in a slurry to seed just before planting and is the most commonly used form in Australia accounting for 92% of all inoculant purchases.

Granular inoculants are available as clay- or peat-based products. Bentonite clay granules, such as ALOSCA®, protect rhizobia to increase their survival in dry, hot or acidic soils. Using a granular inoculant allows for physical separation of rhizobia from potentially toxic seed dressings and fertiliser. Granules must be placed near the seed to enter plant roots.

When faba bean crops are grown in rotation with other crops, inoculum in the soil will generally have reduced significantly before the next faba bean crop; therefore, it is recommended that faba bean seed is inoculated every year it is sown to ensure effective nodulation. Avoid using expired inoculum — it is unlikely to have sufficient numbers of live rhizobia.

Peat vs granular inoculant—what is the right choice for me?

- Peat is the most cost-effective and produces great results in good conditions. It is more suited to sowing into moisture or soils with higher clay content. Store at approx. 4°C and apply to seed within the 24 hours prior to sowing
- Clay granule inoculants provide increased protection to rhizobia, which is beneficial when dry sowing. Provides physical separation from seed dressings and fertiliser. Easier to store than peat but much larger quantities are needed. Ideally its application is via a third seeder box
- See the inoculation quick guide at the end of this Section (Table 4.3) for a more detailed comparison of peat and granular inoculants

Applying peat at seeding

Peat inoculum is highly effective provided it is stored and applied correctly. It should be stored at close to 4°C and not be exposed to temperatures above 15°C or below freezing. Apply peat directly to the seed in a slurry just before seeding, usually as the seed is being augured into the seeder box or truck. Each peat inoculant product has recommended application details on the label. Peat slurries can also be applied to the seed in bulk quantities and mixed by hand or mechanically, such as in a cement mixer.

Apply the slurry within 12 hours of mixing and sow within 24 hours of application. Applying peat in its dry state directly in the box (dry dusting) is not recommended, as this increases the risk of rhizobium death and reduces the likelihood that the rhizobia will stick uniformly to the seed and thus be available to emerging roots.

Applying granular and liquid inoculants at seeding

Granular inoculant (e.g. ALOSCA®) is sown with or below the seed like fertiliser. Ideally, granules should be applied via a third air-seeder box (separate to the seed and fertiliser boxes).

Liquid, freeze-dried, or peat inoculants can be applied in the seeding furrow using a liquid injection kit. The inoculant is applied at a very low pressure in 40L of water per hectare. Agitation during application and a water pH that is within the suitable range (as with soils, pH 5.5–8 $CaCl_2$) is required for this method to succeed. Compatibility with various trace elements applied with a liquid injection kit is currently not well understood and it is not recommended to mix inoculant and trace elements.

Granular legume inoculant

Factors that affect rhizobia survival at seeding

Dry sowing

Sowing faba bean seed at a depth of 5–10cm helps increase the survival rate of rhizobia; however, faba beans can successfully emerge from 15–20cm in moist conditions. When dry sowing with peat, freeze-dried or liquid inoculant, it may be beneficial to double the inoculum rate to ensure sufficient levels of rhizobia are present when plants begin to germinate. Inoculum viability can decline very rapidly in warm and dry soils, so if sowing when soil temperatures are above optimal levels, sowing as close as possible to expected rains is recommended. Granular inoculants are generally preferred when dry sowing.

Seed dressings

The requirement to use fungicidal and insecticidal seed dressings in WA is generally low. Pulse Australia (http://www.pulseaus.com.au/) suggests that it is generally more important to have healthy rhizobia for nodulation and plant growth than it is to have a fungicidal seed dressing.

Fungicidal or insecticidal seed dressings and various fertilisers can be toxic to rhizobia. Fertilisers are likely to be toxic when they are in an acidic solution (pH($CaCl_2$) below 5) or highly alkaline and when they contain toxic substances such as mercury, copper, and zinc (Zn). This includes superphosphate and mono-ammonium phosphate (MAP) fertilisers. Usually, fertiliser can be physically separated from the seed throughout inoculation and seeding; however, if contact between inoculated seed and fertiliser is likely, it may be beneficial to opt for a granular inoculant to better protect the rhizobia.

When using fungicidal and insecticidal seed dressings the following steps can improve inoculation outcomes:

- Read the product label and follow any instructions to determine if ‘safe’ or to minimise toxicity.
- Where possible opt for a granular inoculum to ensure physical separation of rhizobia from any toxic substance.

If not able to use a granular inoculum:

- Apply the seed dressing to seed first, according to the label instructions, and allow to dry.
- Apply the rhizobia inoculant as close to seeding as possible.

If using seed dressings and dry sowing, doubling the inoculum rate may ensure sufficient rhizobia survive to plant germination.

Soil characteristics that affect nodulation

How acidic soil affects nodulation

Faba beans are less tolerant than lupins to acidic soil but can successfully grow and nodulate in soils with pH as low as 5.5 ($CaCl_2$). Rhizobium pH tolerance for each group is summarised in Table 4.1. Levels below pH 5 will significantly impede nodulation and applying lime (liming) is recommended before sowing faba beans in soils with this level of acidity. Below pH 4.8 ($CaCl_2$), aluminium toxicity can also become an issue. Researchers continue to look for more tolerant rhizobia species and, in the future, more acid-tolerant rhizobia may be available.

Table 4.1: Rhizobia strains as classified by their commercial inoculant group, their preferred legume hosts, and optimal pH $CaCl_2$ ranges for nodulation.

Rhizobia Inoculant Groups	Legume Hosts	pH Range
E and F	**Faba bean**, field pea, lentil, vetch	5.5–8
G and S	Lupin, serradella, mungbean, cowpea	4.5–7
B and C	Clover	5–8
N	Chickpea	6–8.5
AL and AM	Medic and lucerne	6.5–8.5

Source: Drew et al. (2019) Inoculating Legumes: A practical guide

Soil nutrients

Soils with high levels of nitrate can restrict nodulation and N fixation. This is because faba beans will take up readily available soil nitrate before beginning active N fixation and will continue this process until the soil nitrate is depleted. During this time, nodules will usually still form on the roots but will be small, white instead of pink, and less active.

Some trace elements are critical for nodulation and N fixation in pulses, with the most important being molybdenum (Mo). Mo deficiency can be an issue in WA on sandplain soils, acidic soils, and where root-pruning herbicides (especially Groups A and B) have been used; however, maintaining a soil pH above 5.5 ($CaCl_2$) will minimise any likely deficiency issues. If choosing to apply Mo in a seed dressing, avoid forms that are toxic to rhizobia. Molybdenum trioxide and ammonium molybdite are compatible with rhizobia; however, sodium molybdite is toxic and should not be used.

Soil moisture and temperature

A dry seed bed can impede nodulation as it can decrease the survival rate of rhizobia. This is amplified in sandy soils and when soil temperatures are high (may occur during early autumn). In soils with high clay content and when seeding occurs in cooler temperatures (late autumn or winter), rhizobium will be largely unaffected in dry conditions. Rhizobia have the highest activity when soil temperatures are between 15°C and 30°C. Extended periods of waterlogging will also significantly reduce rhizobia survival as the bacteria require oxygen for respiration — oxygen is reduced in waterlogged soil.

Can I dry sow faba beans and still get a good inoculation?

- Rhizobia are largely unaffected by dry sowing if the soil temperature is below 30°C, especially if the soil has a high clay content
- If dry sowing into warm soil with no rain expected soon after sowing, it may be better to opt for a granular inoculant to provide extra protection to the rhizobia or double the rate of peat inoculum

Nitrogen fixation

Faba beans nodulate freely as opposed to poorer nodulating pulse species such as chickpeas. They are considered 'aggressive' nodulators, which means they can sufficiently obtain all the N required for production when properly inoculated with healthy rhizobia. Crown nodules are the most effective at fixing N and usually only form when seed is inoculated before sowing. A plant with both crown nodules and nodules on the lateral roots indicates inoculation was successful and the rhizobia have spread into the soil.

For every one tonne of faba bean seed produced by a crop, approximately 41kg of N is removed from the soil. The amount of N fixed by faba beans is provided in the GRDC's 'Inoculating Legumes' guide and is summarised in Table 4.2. This guide estimates that faba beans fix 65% of their total N requirement for the season. Nitrogen fixation from faba beans will be highest when soil N levels are below 50kg/ha in the first 1.2m of the soil profile.

Figure 4.1: Faba bean roots with good nodulation (left) and poor nodulation (right).

Table 4.2: Estimates of the amount of N fixed in a season by legume crops in Australia.

Legume	% N fixed	Total N fixed (kg/ha)	Total crop N (kg/ha)	Shoot N (kg/ha)	Root N (kg/ha)	Shoot dry matter (t/ha)
Lupin	75	130	176	125	51	5.0
Field pea	66	105	162	115	47	4.8
Faba bean	65	110	172	122	50	4.3
Lentil	60	58	96	68	28	2.6
Chickpea	41	70	170	85	85	5.0

Source: Drew et al. (2019) Inoculating Legumes: A Practical Guide.

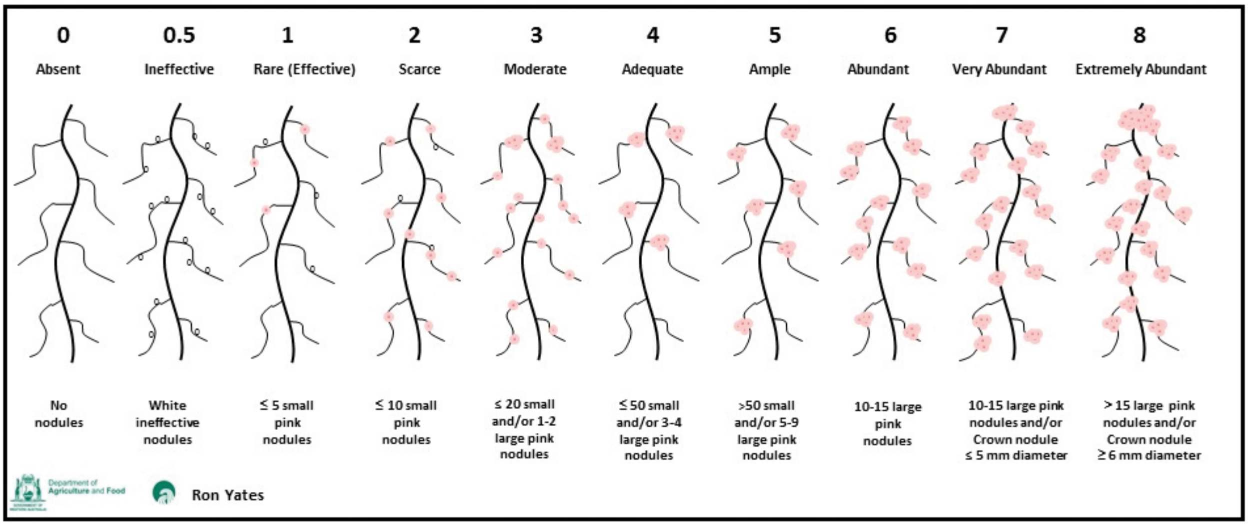
Assessing nodulation

Assess nodulation eight to 10 weeks after seeding (nodules should be visible by six weeks). To assess carefully, dig up plants with roots intact and rinse the root system with water so the nodules are easily visible. Young nodules will be small and white. Nodules that are actively fixing N will be larger and will be pink to red when cut open. These should be most evident on the tap root.

Figure 4.2: Washed faba bean roots with active nodules.

A general rule of thumb for nodulation assessments is that inoculation is successful when you count 100 nodules per plant in loam and clay soils or 20 nodules per plant in sandy soil. This is not a 'hard and fast' rule and growers should use a more subjective approach to assess nodulation, taking into consideration nodule size, position on the root and colour, as many small nodules on lateral roots may fix the same amount of N as a few large crown nodules. Figure 4.3 provides a guide for a comprehensive nodulation assessment (scores of four or higher indicate successful inoculation).

Figure 4.3: Nodulation assessment guide created by Ron Yates, DPIRD.



Sometimes, nodules may be green, which is a sign that they are not fixing N. This may occur because sufficient levels of N for crop growth are available in the soil or due to deterioration from stress or senescence. Plants can produce more nodules and begin active N fixation again if the stress is removed. Black nodules are a sign that the nodules are dying and are often seen as the crop matures or if the plant has been under severe or prolonged water stress. If inoculation was unsuccessful or seed was not inoculated before sowing, a grower may need to consider a post-emergent application of N fertiliser to achieve adequate yield.

Table 4.3: Inoculation quick guide.

Situation	Peat inoculant	Granular inoculant
Application method	Slurry applied directly to seed within 12 hours of mixing.	Sown/banded with the seed.
Sowing window	Within 24 hours of application, as soon as possible.	Not applicable (N/A)
Machinery investment	Optional: Buy/build specialised application equipment.	Ideally applied via a third seeder box, though can be used without (mixed in with seed).
Dry sowing	Fine in heavier soil types. May be beneficial to double the inoculum rate in sandy and/or warm soils.	Good results, safer choice.
Sowing into moisture	Good results.	Good results.
Clay soil	Good results.	Good results. May not be worth the extra cost over peat if conditions are good.
Sandy soil	Good results when sown into moisture. May be beneficial to double the inoculum rate if dry.	Good results.
Acidic soil	Good results if pH above 5.5. May be beneficial to double the inoculum rate if soil is also sandy and/or warm.	Good results if pH above 5.5
Fertiliser	Keep physically separated. Avoid toxic fertiliser.	Provides physical separation. Do not mix with fertiliser in seeder box. Avoid toxic fertiliser.
Seed dressings	Good results if seed dressing is compatible. Apply inoculum after seed dressing. May be beneficial to double the inoculum rate.	Good results, safer choice.
Storage	Keep at approx. 4°C (refrigerated) and out of direct sunlight.	Can be kept at ambient temperature. Keep out of direct sunlight.

Remember:

- Dry dusting with peat will significantly reduce rhizobia efficacy and survival as rhizobia cannot stick to the seed
- Fertilisers and seed dressings that contain toxic substances must be physically separated from the inoculant
- Nodulation will be low with high levels of soil N at seeding; however, as the crop grows it will deplete residual soil N stores and start nodulating if rhizobium remain living in the soil
- Poor nodulation may be a result of issues during inoculation or due to an environmental factor such as high soil temperature, high soil N, or waterlogging

Further reading

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Sarah Belli at
Condingup, 2020

5. Nutrition

Sarah Belli, DPIRD Albany

Key points

- Good fertiliser practices for cereals and canola are suitable for faba bean production, except little or no N fertiliser is required
- Nitrogen application (more than 10–15kg/ha N) at sowing is unnecessary — applying N can reduce N fixation
- Faba beans are responsive to phosphorus (P) and have a high P requirement
- The soil pH plays a vital role in nutrient availability — the balance of nutrients is important for crop performance

Faba bean nutrient removal rates

Even though faba beans can fix N in the soil, harvesting them for grain removes N. While the amount of N, P, and potassium (K) removed by harvesting faba beans is more than wheat and barley for equivalent grain weights, similar amounts are removed per hectare for expected yields as yields for cereals are typically higher than faba beans (Table 5.1).

Table 5 1: Nutrient removal per 1 t of grain.

Nutrient	N	P	K	S	Ca	Mg	Cu	Zn	Mn
	(kg)					(g)			
Faba bean	41	4	10	1.5	1.3	1.2	10	28	30
Lupin	40	3.9	8	2.3	2.2	1.6	5	35	18
Wheat	23	3	4	1.5	0.4	1.2	5	20	40
Barley	20	2.7	5	1.5	0.3	1.1	3	14	11

Note: Values may vary by 30% or more based on different soil fertility.
Source: Adapted from GRDC (2018) GrowNotes Western Region: Faba Bean.

Nutrients

Phosphorus (P)

Phosphorus is a critical nutrient for faba beans. A faba bean crop requires 100–200kg/ha of superphosphate (9–18kg/ha P), depending on soil test results, or at least equal to the P required for a wheat crop in the same paddock. To achieve the response to P fertiliser, the Zn levels must be adequate; the same applies for Zn being responsive when P is adequate.

High phosphorus requirement on P-binding forest gravels

Ben Webb has been growing faba beans for five years on his farm in Muradup, near Kojonup. His farm has high P-fixing forest gravel soils, with Phosphorus Buffering Index ranging from 130–455 in his 2020 faba bean paddock, and Colwell P (mg/kg) of 59–77. When the P sorption of a soil is high, less P is available for plant uptake. Ben's fertiliser strategy for faba beans is to spread muriate of potash over summer, before applying MAPSZC®. Some of the white gum country on the farm has high pH soil and Ben is finding manganese (Mn) deficiency in the crop. At seeding, he applies manganese sulfate along with the MAP in these areas.

See Section 12 for further details of this grower's methods.

Nitrogen (N)

Research has found that applying higher rates of N fertilisers at seeding can inhibit nodulation, due to the sensitivity of rhizobia to acidic chemicals; therefore, banding fertiliser away from the rhizobium placement will be beneficial. As N fixation is an energy-intensive process for the plant, it will prefer to take up mineral N from the soil if available, rather than fix its own N. Therefore, high soil-available N can lead to poor nodulation and poor N fixation. However, if faba beans lack early vigour and are growing on sandy loam soils (pH($CaCl_2$) below 6.5), low rates of N application (10–15kg/ha) can be beneficial. At this level nodulation will not be compromised; however, there is no evidence of a yield response.

Potassium (K)

Most soils where faba beans are grown have adequate K levels in the top 50cm or sub-soil. However on sandy soils with Colwell K < 40ppm, topdressing 20-40kgK/ha as Muriate of Potash 6-8 weeks after sowing may be beneficial.

Trace elements

Trace elements that can reach toxic levels in soil for faba beans are aluminium (Al) manganese (Mn) and boron (B). Al and Mn become more available in acidic conditions and can be toxic to rhizobia — this is another reason why achieving target soil pH is important. Boron becomes more available in alkaline conditions, mostly present in low-rainfall clay subsoils, such as those found around Grass Patch.

Molybdenum (Mo)

To fix N, pulses require the trace element molybdenum (Mo). The enzyme responsible for converting atmospheric N to Al is called nitrogenase, and it requires adequate Mo to function optimally. Some growers apply Mo as a fertiliser at seeding, as low pH reduces Mo availability.

Zinc (Zn)

With adequate P, faba beans are very responsive to zinc (Zn). Zn deficiency can be identified as the yellowing of the leaves between the veins and on the lowest leaves on the stem. Zn can be applied as a foliar application, which can fit in with herbicide or an early fungicide application. If Zn is applied within the first six to eight weeks of plant emergence, it can correct a mild Zn deficiency. A soil application, which has a residual life of five to eight years, is needed to correct severe Zn deficiency; however, a foliar application may still be required in the year the soil Zn is applied. Zn is immobile and must be worked in to ensure it is evenly distributed into the topsoil. Zinc present in compound fertiliser may often meet the requirements of the crop.

Table 5.2: Nutrient and trace element deficiency symptoms.

Nutrient or trace element	Deficiency symptoms
Phosphorus	Plant size and development varies and the leaves on P-deficient plants are smaller. On the oldest pair of leaves there is mild mottled chlorosis over most of the surface area of the leaf; however, new and middle leaves remain green and so can be confused with N or sulfur deficiency.
Nitrogen	The whole plant becomes pale. New and slightly older leaves become cupped, while older leaves become mottled.
Potassium	Plants lose the lower leaves, have poorer height and vigour. The leaf margins can turn grey before they die.
Sulfur	The youngest leaves yellow and the plants are slender and small.
Molybdenum	Leaves become pale with mottling between the veins. Brown scorched areas are visible between the veins.
Zinc	Leaves yellow between the veins and on the lowest leaves on the stem.
Copper	First noticed at flowering when leaves start to wilt and roll from the base of the leaf. Flowering looks normal and is not delayed; however, few pods are formed and little seed is produced.
Iron	Observed on high pH soils that are temporarily waterlogged. Waterlogging interferes with iron absorption and movement into the plant. Plants usually recover quickly as the waterlogged area becomes drier.
Boron	Affects the root system, which turns brown and roots become shorter and thicker. Leaves are stunted or deformed and flowers are also deformed.
Manganese	Mild chlorosis appears, followed by a small dark dead spots or the purpling of mid–rib and lateral veins.

Source: Adapted from GRDC (2018) GrowNotes Western Region: Faba Bean.

Fertiliser placement

Fertilisers, like crop protection chemicals, can be toxic to sensitive rhizobia. Avoid exposing inoculated seed to fertiliser, including superphosphate.

- It is common practice to drill fertiliser below the seed — drilling fertiliser with the seed can reduce inoculation due to toxicity
- The amount of fertiliser down the tube depends on row spacing. Wide-row crops require more fertiliser in the seed row to meet the required rate per hectare
- Research in WA has shown that up to 150kg/ha of double superphosphate (26kg P/ha) can be sown with seed on 38cm row spacing. This information was published in the Department of Agriculture and Food Western Australia Bulletin 4645 'Producing pulses in the southern agricultural region'
- Top-dressed phosphate fertilisers are about half as effective as drilling the fertiliser with the seed in areas with finer-textured soils where faba beans are typically grown

Further reading

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6. Weed Management

Emma Pearse, DPIRD Esperance

Key points

- Select a paddock with a low weed burden because faba beans are not good competitors
- There are increasing post-emergent herbicide options; however, good pre-emergent herbicide control applied before seeding (incorporated by sowing [IBS]) or post-sowing pre-emergence (PSPE) is essential to reduce pressure on post-emergent sprays
- Faba beans are an alternative break crop to canola as they allow the use of different herbicide groups and better control of grass weeds, including some herbicide-resistant weeds
- Crop-topping is useful for reducing weed seed-set for following seasons

Growing faba beans between cereal crops allows different weed control tactics to be used, particularly those that target grass weeds. However, faba beans can be poor weed competitors due to their slow germination, low early vigour and delayed canopy closure. This is exacerbated when planting density is low. Broadleaf weed control is particularly difficult in faba beans as few registered post-emergent products are effective and available.

Knowing the likely weed burden of the paddock is essential for planning what pre-emergent and post-emergent herbicides are necessary. This makes paddock selection very important. As faba beans are not great competitors, growers must be aware of resistance issues on their farm and be aware of mixing and rotating different herbicide groups to target these populations.

If weeds are not well managed in faba bean crops, yields can drop dramatically. When selecting paddocks for growing faba beans, watch out for these weeds:

- annual ryegrass
- wild radish
- wild turnip
- capeweed
- marshmallow
- volunteer canola

Integrated weed management

When including a legume like faba bean in the crop rotation, integrated weed management (IWM) becomes even more important because weed control in season can be difficult. Keep weed numbers low by using both chemical and non-chemical tactics.

WeedSmart® is an industry-led initiative that aims to help growers and advisors adopt farming practices that better preserve current herbicides and reduce the development of herbicide resistance. WeedSmart® devised the 'Big 6' for growers to follow:

1. Rotate crops and pastures
2. Double knock to preserve glyphosate
3. Mix and rotate herbicides
4. Stop weed seed-set
5. Crop competition
6. Harvest weed seed control.

To learn more about IWM methods, go to the WeedSmart® website: www.weedsmart.org.au

Selective grazing for weed control

Faba beans have relatively low palatability, particularly to sheep, according to a study by the University of Adelaide (GRDC (2017) GrowNotes Southern Region: Faba Beans). Therefore, early grazing can be used for weed control. For best results, introduce sheep early (at low stocking rates) before the plants get too bulky — this reduces the risk of trampling and snapping branches. Sheep must be removed from the faba bean crop before flowering and before they do too much visual damage to the crop.

Grazing to target problem weeds

Rohan Marold uses grazing in his faba bean crops, introducing sheep into the paddock once the crop has established some substantial vegetative growth. To avoid trampling, he removes the sheep before the beans get too large. He finds that the sheep prefer to eat his problem weeds (wild radish and capeweed), and are another tool in his weed management plan.

See Section 12 for further details of this grower's methods.

Pre-emergent herbicide options

Getting good weed control from your pre-emergent herbicides is important to target weeds that germinate with the crop and compete for water and nutrients. With limited post-emergent herbicide options and the current limited efficacy of some pre-emergent herbicides, choosing the right program for the weeds present is important. Most pre-emergent herbicides are applied before sowing to be incorporated by sowing (IBS) to reduce potential damage to the crop. As faba beans can be sown deep, some pre-emergent herbicides can be applied PSPE. This application timing is ideal to target weeds that would otherwise remain in the furrow if herbicides are only applied IBS. Some herbicides can be applied in a split application, both IBS and PSPE, to get better coverage, depending on soil conditions. NOTE: Rainfall soon after application is important to achieve the best efficacy from the herbicide.

Fomesafen (e.g. Reflex®), a new herbicide registered by the Australian Pesticides and Veterinary Medicines Authority (APVMA) in March 2021, has shown promising broadleaf weed control in field trials across the south coast. This herbicide is registered for pre-emergent use only and can be applied IBS and PSPE. With longer residual activity (up to 12 weeks), this herbicide has the potential to control later-germinating weeds, with particularly good control of wild radish and the suppression of capeweed. A DPIRD trial in 2020 showed good weed control from using fomesafen - broadleaf weed numbers were suppressed over a 12-week period, at which time most of the remaining weeds were at the cotyledon or four leaf growth stage. Table 6.1 lists other pre-emergent herbicides registered by the APVMA for use in faba beans.

Post-emergent herbicide options

Grass weeds can be controlled in season by using grass-selective herbicides (see Table 6.2). Be aware that these herbicides can cause leaf spotting damage on faba bean leaves, which can be confused with chocolate spot and other foliar diseases (Figure 6.1). Using a mix of herbicide groups is important when controlling grass weeds as resistance to Group A herbicides is increasing. Faba beans can be used as an alternative break crop to canola to control grass weeds because a higher rate of butroxydim (e.g. Factor®) can be applied. This added control can help reduce grass weed populations.

Post-emergent herbicide options registered for faba beans are outlined in Table 6.2. If wide-row spacing and shielded spraying is used, the number of post-emergent herbicide options increases. Shielded sprayers are set up to separate the crop from herbicides (such as glyphosate, to which faba beans are relatively tolerant) that are applied to target weeds germinating between crop rows.

Currently, there are few registered post-emergent herbicide options for broadleaf weed control

Figure 6.1:
Chocolate spot (left) compared to grass-selective herbicide damage (right) on faba bean.

in faba beans; therefore, it is important to select paddocks that have a low weed burden and to ensure effective pre-emergent herbicide sprays. At the time of publication of this document, only two herbicides are registered for post-emergent application across all faba bean varieties — pyraflufen-ethyl (e.g. Ecopar®) and imazamox (e.g. Raptor®). Currently Raptor® is only registered for use on faba beans under an APVMA permit (PER14726) until 30 September 2024.

Because these post-emergent herbicides have limited efficacy on broadleaf weeds and can cause significant crop damage to young plants (Figure 6.2a), many growers do not spray a broadleaf herbicide over their faba beans. Trials in 2020 by DPIRD in the Gibson and Frankland areas showed that pyraflufen-ethyl has moderate weed suppression on clover and capeweed; however, it causes dark spots and discolouration in the crop soon after application. The same trials showed that the faba bean crop did grow out of this early discolouration (Figure 6.2b). Crop damage from imazamox was minimal in this study, but so was weed suppression.

Some registered herbicides containing imazomox and imazapyr (eg. Intervix®) have a minor use permit for use on IMI-tolerant faba bean varieties (PBA Bendoc) (Permit 86849) until 30 April 2022. This use is now also on the Intercept® label. These herbicides should not be used on varieties that are not IMI-tolerant as severe crop damage can result (Figure 6.3).

Figure 6.2: Ecopar® (pyraflufen-ethyl) damage on PBA Amberley faba bean at Gibson 2020. Photo (a) taken 2 weeks after application; photo (b) taken 6 weeks after application shows limited damage to the plants.

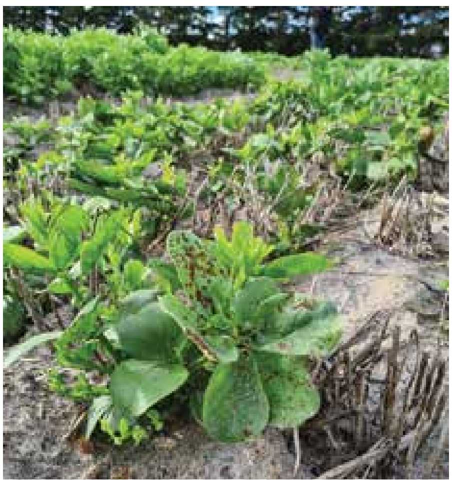

Figure 6.3: Stunting, discolouration, and spotting caused from spraying Intercept® (imazamox and imazapyr) on faba bean variety PBA Amberley at Gibson 2020. (Note: PBA Amberley is not IMI-tolerant)

Crop-topping for weed control

Crop-topping is useful for controlling ryegrass and other late-germinating weed populations in faba bean crops. Crop-topping should be done before weed seed-set occurs to reduce broadleaf and grass weed carryover into the following season. Glyphosate and paraquat are registered for crop-topping in faba beans. Some growers use a double-knock crop-topping strategy to control hard-to-kill weeds. In this scenario, glyphosate is applied first to kill most weeds, then paraquat is applied later to pick up any leftovers, particularly any that are resistant to glyphosate. In medium- to low-rainfall areas, often only paraquat is applied. NOTE: Crop-topping using only paraquat is recommended where possible to reduce the risk of weed populations developing resistance to glyphosate.

Timing of crop-topping can be difficult as it can also affect crop yield and seed quality. Crop-topping can be paired with desiccation; however, targeting the correct weed stage can mean the spray is applied earlier than recommended for crop desiccation resulting in yield loss and damaging the seeds. For desiccation, seeds in pods at the top of the plant must have a black hilum and the grain should be 75–90% mature (see Section 10 for more information on desiccation timing).

Crop-topping/desiccation herbicide options registered for faba beans are outlined in Table 6.3. Always read the label for specific application instructions.

Faba bean crop with patches of wild radish

Registered Herbicides

Table 6.1: Pre-emergent herbicides (with example trade names in brackets) registered for controlling various weeds in faba beans.

Herbicide	Timing	Legacy HRAC MOA*	HRAC MOA 2020	Weeds controlled	WHP for grazing
Carbetamide 900g/kg (e.g. Ultro®)	IBS	E	23	Ryegrass, brome grass, and barley grass	12 weeks
Cyanazine 900g/kg (e.g. Bladex®)	IBS	C	5	Controls ryegrass, capeweed, doublegee, mustard, and turnip Suppresses wild radish	N/A (do not apply post-emergence)
Diuron 900g/kg	IBS or PSPE	C	5	Broadleaf weeds	35 days
Flumioxazin 500g/kg (e.g. Terrain®)	IBS	G	14	Various broadleaf and grass weeds	12 weeks
Fomesafen (e.g. Reflex®)	IBS or PSPE	G	14	Various weeds, particularly targeting wild radish, sowthistle, and fumitory	12 weeks
Imazethapyr (e.g. Spinnaker®)	PSPE	B	2	Broadleaf and grass weeds	14 days
Metribuzin 750g/kg	PSPE	C	5	Broadleaf and grasses	None
Pendimethalin 440g/L	IBS	D	3	Controls ryegrass Suppresses silver grass and wild oats	None
Propyzamide 900g/kg (e.g. Edge®)	IBS	D	3	Ryegrass, winter grass, barley grass, silver grass, and great brome	12 weeks
Prosulfocarb/ s-metolachlor (e.g. Boxer Gold®)	IBS	J and K	15	Grass weeds (ryegrass and silver grass)	10 weeks
Simazine 900g/kg WG	IBS or PSPE	C	5	Grasses, capeweed, medic, and mustard	8 weeks
Terbuthylazine 875g/kg (e.g. Terbyne Xtreme®)	IBS or PSPE	C	5	Controls medic, sowthistle, and wild turnip Suppresses ryegrass, wild radish, and silver grass	6 weeks
Tri-allate 500g/L	IBS	J	15	Wild oats	13 weeks
Trifluralin 480g/L	IBS	D	3	Various broadleaf and grass weeds	None

Notes:
IBS = incorporated by sowing; PSPE = post-sowing pre-emergent; WHP = withholding period
Always read the label to check that the specific product being used is registered for planned use before applying.
**Herbicide Resistance Action Committee Mode of Action Classification 2020*

Table 6.2: Post-emergent herbicides (with example trade names in brackets) registered for controlling various weeds in faba beans.

Herbicide	Legacy HRAC MOA*	HRAC MOA 2020	Weeds controlled	WHP	Notes
Butroxydim 250g/kg (e.g. Factor®)	A	1	Ryegrass, barley grass, and wild oats	Harvest – N/A Grazing – 14 days	Use lower rates for younger weeds, and higher if there is suspected resistance
Clethodim 240g/L	A	1	Grass weeds	Harvest – N/A Grazing – 21 days	Do not apply beyond full flowering
Fluazifop-p 128g/L (e.g. Fusilade Forte®)	A	1	Grass weeds	Harvest – 5 weeks Grazing – 7 weeks	5-week WHP for harvest
Haloxyfop-R 520g/L (e.g. Verdict®)	A	1	Grass weeds	Harvest – N/A Grazing – 28 days	Apply at least one week apart from broadleaf herbicide application
Imazamox 700g/kg (e.g. Raptor®)	B	2	Various annual grasses and broadleaf weeds -check label	Harvest – N/A Grazing – 6 weeks	Special permit for use in faba bean crops (APVMA PER14726 until 30 Sept 2024)
Imazamox 33g/L/imazapyr 15g/L (e.g. Intercept®) Caution: **Only permitted for IMI varieties (e.g. PBA Bendoc)**	B	2	Annual ryegrass (suppression) and broadleaf weeds - check label	Harvest – N/A Grazing – 28 days	ONLY permitted for IMI-tolerant varieties (e.g. PBA Bendoc)
Propaquizafop 100g/L (e.g. Shogun®)	A	1	Grass weeds	Harvest 7 weeks (but 14 weeks if in tank mix with Sertin®) Grazing – 3 days	Use a non-ionic surfactant or Hasten® or Kwickin® as spray adjuvant
Pyraflufen-ethyl 20g/L (e.g. Ecopar®)	G	14	Broadleaf weeds	Harvest – N/A Grazing – 28 days	Apply to crop between 3–5 leaf stage
Sethoxydim 186g/L (e.g. Sertin®)	A	1	Grass weeds	Harvest – N/A Grazing – 21 days	Apply when most weeds are at 2–6 leaf stage
Quizalofop-p-ethyl 200g/L	A	1	Grass weeds	Harvest - 12 weeks Grazing – 4 weeks	Apply when weeds are actively growing

Notes: WHP = withholding period.
Always read the label to check that the specific product being used is registered for planned use before applying.
**Herbicide Resistance Action Committee Mode of Action Classification 2020*

Table 6.3: Crop-topping/desiccation herbicides (with example trade names in brackets) registered for controlling various weeds in faba beans.

Herbicide	Legacy HRAC MOA*	HRAC MOA 2020	Weeds controlled	WHP	Notes
Diquat	L	22	All weeds	Harvest – 2 days Grazing – 1 day	Desiccation
Glyphosate	M	9	Annual weeds	Harvest – 7 days Grazing – check product label	Crop-topping or desiccation
Paraquat	L	22	Annual ryegrass	Harvest – 7 days Grazing - check product label	Crop-topping
Saflufenacil 700g/kg (e.g. Sharpen® WG)	G	14	All weeds	Harvest – 7 days Grazing – 7 days	Desiccation

Notes: WHP = withholding period
Always read the label to check that the specific product being used is registered for planned use before applying.
**Herbicide Resistance Action Committee Mode of Action Classification 2020*

Further reading

Grains Research and Development Corporation (2017) GrowNotes Southern Region: Faba Beans [online document], accessed 27 January 2021. https://grdc.com.au/resources-and-publications/grownotes/crop-agronomy/faba-bean-southern-region-grownotes

Grains Research and Development Corporation (2018) GrowNotes Western Region: Faba Beans [online document], accessed 27 January 2021. https://grdc.com.au/resources-and-publications/grownotes/crop-agronomy/faba-beans-western

Preston C, Boutsalis P, Kleemann S, Saini R and Gill G (2015) Managing resistant ryegrass in break crops and new herbicides for resistant ryegrass: Managing clethodim resistance in annual ryegrass [online document], Grains Research and Development Corporation, accessed 27 January 2021. https://grdc.com.au/resources-and-publications/grdc-update-papers/tab-content/grdc-update-papers/2015/07/managing-resistant-ryegrass-in-break-crops-and-new-herbicides-for-resistant-ryegrass

King Yin Lui in faba bean storage shed

Native budworm caterpillar
feeding on faba bean plant

7. Pest Management

Sarah Belli, DPIRD Albany

Key points

- Regularly monitor crops at early establishment and from flowering to podding
- Monitoring during establishment means control measures can be taken before significant seedling loss occurs. Common seedling pests to look for are earth mites, lucerne flea, cutworms, slugs, snails, aphids, and thrips
- Native budworm is the most damaging pest during podding (caterpillars chew through the pods and damage the seed)

Regular monitoring of faba bean crops will enable early detection of pests, leading to more management options being available. Timing is critical for effective and economically viable control. Some pests are damaging only at a certain crop stage, as detailed in Table 7.1.

Table 7.1: Invertebrate pests of faba beans at different crop growth stages.

Pest	Crop stage				
	Emergence/ Seedling	Vegetative	Flowering	Podding	Grain fill
Earth mites	Damaging	Present	Present		
Native budworm		Present	Damaging	Damaging	Damaging
Lucerne flea	Damaging	Present			
Cutworms	Damaging				
Slugs and snails*	Damaging	Damaging			
Aphids (virus vectors)	Damaging	Damaging	Present	Present	
Thrips		Present	Present		

** Potential grain contaminant at harvest*

Source: Integrated Pest Management Guidelines. Faba Beans (Department of Agriculture and Fisheries, Queensland [2017]).

Economic spray thresholds

Economic spray thresholds developed for some pests are listed in Table 7.2, if known. Insecticides should not be applied unless they are necessary so as to protect pollinators, natural predators, and parasites. Faba beans rely heavily on insect pollinators like bees — if a spray is deemed necessary, then the choice of chemical and the timing of its application must be carefully considered.

Table 7.2: Invertebrate pests of faba beans, crop symptoms, and spray thresholds.

Pest	Crop symptom	Spray threshold, if known
Native budworm	Damaged pods (holes in pods) and damaged seeds.	One caterpillar per 50 sweeps.
Redlegged earth mite (RLEM) and blue oat mite	Leaves show silver discolouration and leaf windowing.	For pulses: 20 RLEM per $100cm^2$ (10 × 10 cm quadrat) is an approximate threshold level; RLEM numbers can be difficult to assess, if crop is not outgrowing feeding damage, consider control.
Bryobia mite (or clover mite)	Sucking damage from tops of leaves causes whitish grey lines and plants look wilted. Resembles RLEM damage.	Control only if crop cannot outgrow feeding damage.
Cutworm	Patchy areas with chewing damage near ground level. Seedling stems can be 'cut' right through.	Cutworm are difficult to find as they burrow underground and feed at night. Thresholds have not been developed.
Lucerne flea	Thinning of seedlings, bare patches, and seedling damage. They jump off plants if you wave your hand over the crop. Prefer heavier soil types.	Spraying may be required if 50% of leaf area is likely to be damaged.
Slugs and snails	Holes in leaves and chewing damage on leaf edges.	In pulses: 5 conical snails per seedling; 5 Italian snails per square metre.
Aphids	Bluegreen and cowpea aphids colonise faba beans. Cowpea aphids colonise whole plants before spreading to adjacent plants, or attack weaker thinner patches in the crop.	30% of inspected plants have been colonised by aphids at 10 locations in the paddock.
Thrips	Distortion of emerging and expanding leaves. Older leaves and pods are marked with silvery-brown blotches.	Not known to affect yield. Damage is considered only cosmetic.

Managing establishment pests

Control the green bridge over summer to reduce insect populations that could threaten the crop at establishment. Paddocks coming out of a pasture phase have higher insect pressure than paddocks coming out of annual crops. An insecticide can be applied with the herbicide knockdown to control establishment pests. Seasons that begin with slow emergence and plant growth, which are associated with cool conditions, increase the risk of high populations of establishment pests.

If snails and slugs are present at damaging levels, spread baits in a small patch in late March to April and look for dead snails and slugs to confirm active feeding. If snails and slugs are actively feeding, spread baits at the paddock scale as per the rate on the label. If green material is present, then baits will be less effective at killing snails and slugs, as they have an alternative food source.

Managing snails with faba beans in Kendenup

A challenge in the Woods' high-rainfall region is managing grain contamination from small conical snails. Jeremy Wood says snails have, so far, not been the issue in the beans that they are in canola and cereals. The Woods are baiting, bashing, and burning windrows after canola to reduce snail numbers. However, to meet tight grain receival standards, they must clean all their canola and sometimes their cereals.

See Section 12 for further details of this grower's methods.

In-crop management

The most damaging insect pest of faba beans in WA is native budworm. Native budworm has a very low spray threshold and needs to be controlled as soon as it is found in the crop. Aphids should also be monitored as the crop matures to make sure infestations do not build up in stressed areas of crops and affect flowering or pod-set. Parasitoid wasps in high enough numbers are effective at controlling aphids by laying their eggs in aphids, which eventually kills them. Parasitised aphids are called mummies (Figure 7.1). No information currently exists on the thresholds of parasitoid wasps required to keep aphid numbers under control.

Figure 7.1: Parasitised cowpea aphids on faba bean plants at Kojaneerup (left). Aphids are killed by parasitoid wasps (right). One week later 100% of aphids are killed. Wasps hatch out of aphid 'mummies' by cutting a round hole in the aphid body.

Native budworm

DPIRD has developed an economic threshold (ET) calculation for native budworm in faba beans. Use the formula below to calculate the ET or the number of native budworm caterpillars that will cause more financial loss than the cost of spraying. Based on the example given below if a single budworm caterpillar is found, the faba bean crop must be sprayed.

Costs that vary from grower to grower are the cost of purchasing and applying chemicals and the grain price per tonne. The ET calculation assumes the crop is swept at early pod formation and is based on this formula (sourced from DPIRD website):

$$ET = C \div (K \times (P \div 1000))$$

Where

ET = economic threshold (numbers of grubs in 10 sweeps)

C = control cost (includes price of chemical + application) ($ per ha)

K = kg/ha eaten for every one caterpillar netted in 10 sweeps or per m^2

P = price of grain per kg (i.e. price per tonne ÷ 1000)

Assumption: 90kg/ha of yield lost per caterpillar netted in 10 sweeps.

Example:

$12 \div (90 \times (280 \div 1000)) = 0.47$ (approximately 1 caterpillar)

Do not delay spraying for native budworm, as the pests can eat the developing seed and damage the grain, causing significant quality penalties. Use a sweep net to determine if budworm are present and conduct sweeps in multiple areas of the paddock from flowering onwards. Sweep in a 180-degree arc while walking through the crop, aiming for the net to be near the top of the canopy. Ten sweeps make up one count; this should be done in at least five locations in the paddock.

Registered Insecticides

Table 7.3: Insecticides with trade name examples in brackets for control of common pests of faba beans (Adapted from the Synergy Agronomy Technical Manual 2020).

Application Type	Insecticide	WHP (days)	RLEM/ BOM	Bryobia mite	Webworm	Aphids	Lucerne Flea	Budworm
Seed dressing	Imidacloprid 600 g/L (e.g. Gaucho®600 Red)	Grazing 16 Weeks Harvest*						
Soil; soil residual; foliar	Bifenthrin (e.g. Talstar®)	Grazing 28 Harvest *						
Foliar	Chlorantraniliprole (e.g. Altacor®)	Grazing 14 Harvest 28						
Foliar	Dimethoate (Dimethoate)	Grazing 14 Harvest 14						
Soil; foliar	Gamma-cyhalothrin (Trojan®)	Grazing 7 Harvest 7						
Soil; foliar	Lambda-cyhalothrin (e.g. Karate Zeon®)	Grazing 7 Harvest 7						
Soil; soil residue; foliar	Omethoate (e.g. Le-Mat®)	Grazing 1 Harvest*						

**Not required if used as directed on label*
Soil: a non-residual knockdown
Soil Residual: bare earth treatment
Foliar: sprayed onto crop

Further reading

Grains Research and Development Corporation (2018) *GrowNotes Western Region: Faba Beans* [online document], accessed 27 January 2021. https://grdc.com.au/resources-and-publications/grownotes/crop-agronomy/faba-beans-western

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Carla Milazzo
at Ongerup, 2020

8. Managing foliar diseases

Carla Milazzo, DPIRD Albany

This Section builds on and updates Chapter 4 'Diseases of pulses' in the publication, Producing pulses in the southern agricultural region (White et al. 2005).

Key points

- At the time of writing, the most recently released faba bean variety PBA Amberley offers the highest genetic resistance to chocolate spot, the main yield-limiting disease
- Monitor crops frequently, especially in spring when warmer temperatures and high humidity favour disease. Aim for early detection and timely spraying to protect flowers and pods
- Seasonal conditions and cultural practices that reduce inoculum load significantly affect disease pressure
- Use an integrated disease management plan to reduce reliance on chemical control

Research conducted by DPIRD in the late 1990s to mid-2000s generated much of the information known about faba bean disease biology, epidemiology, and management in WA. As a result, growers have access to newer faba bean cultivars with superior disease resistance, including PBA Samira, PBA Marne, and most recently PBA Amberley. Growers are also benefitting from recent advances in fungicide and spray technology, which further reduces the risk of disease outbreaks.

An understanding of pathogen life cycles, general characteristics and methods of spread helps growers manage diseases effectively. Chocolate spot, ascochyta blight, cercospora leaf spot, and alternaria leaf spot are caused by necrotrophic fungi that kill plant tissue to acquire nutrients, grow and reproduce. Rusts are biotrophic pathogens that acquire nutrients from live plant tissue and rely on a living host to grow and reproduce. They cause disease by taking nutrients from the plant and reducing green leaf area, which impacts growth and pod-fill. These contrasting 'lifestyles' affect disease management strategies in terms of inoculum carryover and inoculum load between seasons. Biotrophs need a green bridge while necrotrophs do not. Necrotrophic fungi can survive on dead and decaying crop residues.

When current faba bean varieties are grown in the medium- to high-rainfall environment along the south coast of WA, chocolate spot and ascochyta blight are likely to be the most economically important foliar diseases requiring control, depending on varietal resistance. Alternaria leaf spot, cercospora leaf spot, and rust are considered less important diseases in most seasons. Growers should use a range of strategies in an integrated disease management plan to reduce disease pressure.

Integrated disease management strategies at a glance

- **Paddock selection:** Sow faba beans at least 500m away from previous years' stubble. Aim for a break of at least four years between faba bean crops in the same paddock
- **Sowing date:** Target the optimum sowing window for your location but avoid sowing too early
- **Variety selection:** Choose the least susceptible variety to the main disease risk in your region
- **Seed source:** Sow clean seed. Only sow retained seed from disease-free crops, or with less than 10% chocolate spot or 5% ascochyta
- **Harvest management:** Harvest early to minimise disease infection on seed and seed staining. Consider desiccation as a tool to enable earlier harvesting
- **Foliar fungicide:** Monitor foliage frequently to enable timeliness of spraying with the right fungicide. Efficient fungicide use protects plant tissue rather than curing existing infections. Sprays are required if seasonal conditions favour disease development and spread. Time the first fungicide, if required, to minimise disease establishment. Experienced growers often apply a fungicide just before canopy closure, with later sprays based on the seasonal outlook and disease pressure in the crop
- **Wide-row spacing** delays or prevents full canopy closure and keeps the canopy drier more often, meaning conditions are less conducive to disease development

Identifying disease

Diseases must be diagnosed accurately to avoid unnecessary spraying or incorrect fungicide use. Disease symptoms can be confused with herbicide damage, and some diseases like ascochyta, alternaria, and cercospora can look very similar. It is also common for multiple diseases to be present at the same time, and for insect damage, herbicide damage or physical damage to predispose the crop to disease infection. Table 8.1 summarises the main characteristics and symptoms of the diseases discussed in this chapter.

Chocolate spot

In the southern grain growing areas of WA, chocolate spot is a disease of early spring, as it likes warm, humid conditions. Chocolate spot symptoms are described in Table 8.1 and shown in Figure 8.1 to Figure 8.3. RLEM feeding damage and herbicide damage can sometimes be mistaken for early symptoms of chocolate spot. If unsure, a quick test is to place a moist tissue and the suspect lesions in a sealed plastic bag and leave it overnight. The humidity in the bag will cause chocolate spot lesions to sprout fruiting bodies and spores that resemble grey mould.

Chocolate spot is most damaging during flowering as it leads to flower abortion and thus reduced pod-set. In severe cases, chocolate spot also infects stems, which can cause lodging (Figure 8.2).

Lifecycle

The pathogen *Botrytis fabae* can have a very short latent (incubation) period of one to three days under ideal conditions, meaning its windborne spores can germinate and infect the crop rapidly. It can also remain latent in the plant for weeks under non-ideal conditions. Thus, weather is the critical factor determining the risk of infection, disease severity, and yield loss.

Infected plant material dies and drops from the plant and spores are released from fruiting bodies, which may appear as grey fluffy mould. Spores spread within the crop via wind and rain splash. The fungus survives on infected faba bean stubble and residues over summer in a semi-dormant state. Windborne spores are released the following season when conditions are ideal, with most landing within a few hundred metres of their origin.

Management

The risk of infection increases when sowing near stubble from a previous host crop and when sowing early. Extending the growing season gives the disease more time to build up and is also likely to increase crop biomass, which can lead to early canopy closure and a more conducive environment in spring. Crop damage from insects, herbicides or physical injury, or pre-existing disease infection (e.g. ascochyta blight) predisposes the crop to chocolate spot infection.

To manage chocolate spot:

- Sow at least 500m away from the previous year's crop
- Wait at least four years before sowing a paddock back into faba beans
- Grow a cultivar with good chocolate spot resistance (e.g. PBA Amberley, MR MS; see Table 8.2)
- Wide rows delay or prevent canopy closure and reduce leaf wetness duration
- Monitor the crop frequently, especially in spring
- Use a fungicide if conditions are conducive for a disease outbreak, ideally before canopy closure. Aim to protect the flowers and if multiple sprays are required, mix and rotate modes of action

Table 8.1: Foliar diseases of faba beans in WA and their characteristics.

	Chocolate spot	Ascochyta blight	Cercospora leaf spot	Alternaria leaf spot	Rust
Pathogen	*Botrytis fabae*	*Ascochyta fabae*	*Cercospora zonata*	*Alternaria alternata*	*Uromyces viciae-fabae*
Lifestyle	Necrotroph	Necrotroph	Necrotroph	Necrotroph	Obligate biotroph
Alternative hosts	Vetch, lentil	Vetch	None	Many	None
Timing	Early spring (warm, humid conditions)	Winter (4–8 weeks after sowing)	Winter (6–8 weeks after sowing)	Spring (wet conditions)	Spring (warm conditions)
Plant parts most affected	Leaves, flowers, stems, pods	Leaves, stems, pods	Leaves, stems (mostly lower canopy)	Leaves, stems	Leaves, stems
Leaf symptoms	Small red-brown spots scattered/peppered on one side of leaves, and stems and flowers. Late infection the lesions enlarge and coalesce rapidly to form bigger grey-brown necrotic patches with irregular shaped margins and red-brown coloured border. The centre is often lighter. They can cause complete defoliation.	First appear as grey spots showing through on both sides of the leaf. Develops into dark lesions with grey centres with pycnidia visible. Centres of lesions can drop out, leaving holes. Lesions coalesce slowly.	Dark brown (darker than alternaria) lesions with irregular shaped, distinct margins. Concentric rings may develop inside lesions. Lesions coalesce slowly.	Dark brown lesions with obvious concentric grey-brown rings in the centre (like a target), with red-brown margins. Lesions coalesce slowly.	Creamy coloured spore masses on leaves, replaced by orange-brown pustules surrounded by yellow halo. Orange spores from pustules can be brushed off. Later infection of the stem appears as brown-black masses with pale halo.
Fruiting bodies visible	Not in the lesions, but in severe infections, masses of grey spores may be visible on decaying plant tissue or flowers.	Yes, tiny black dots (pycnidia) in centre of lesions.	No	No	Yes, in orange pustules.

Figure 8.1: Chocolate spot infection.

Figure 8.2: A faba bean crop lodging under heavy chocolate spot infection.

Figure 8.3: Leaves showing symptoms of cercospora and chocolate spot.

Figure 8.4: Cercospora lesions with concentric rings look similar to alternaria.

Figure 8.5: Cercospora lesions.

Figure 8.6: Pycnidia are visible in the centre of ascochyta blight lesions.

Source: extensionaus.com.au

Figure 8.7: Alternaria lesion.

Source: Jean Galloway, DPIRD

Figure 8.8: Faba bean rust.

Source: Bill McLeod, formerly Department of Agriculture and Food, WA

Real-time spray alerts for chocolate spot

Remote sensing of weather and microclimatic conditions shows early promise for supporting fungicide spray decisions in real-time. The chocolate spot fungus requires specific conditions to sporulate and infect faba beans. Specifically, warm temperatures (15–25°C) and high humidity (at least 70% relative humidity) for 12 consecutive hours is required. These conditions typically occur during flowering and canopy closure. The increasing capacity of remote sensing and more reliable farm connectivity has enabled researchers to monitor the microclimate in crop canopies and determine the risk of disease outbreaks in the field. Remote sensors can monitor temperature, humidity, and leaf wetness and relay data every hour, while calculating spray alerts based on canopy conditions.

This research aims to improve spray decision support by reducing prophylactic (preventive) spraying when conditions are not conducive to chocolate spot infection. DPIRD in WA and the South Australian Research and Development Institute (SARDI) are working to test and refine spray alert algorithms for chocolate spot. It is hoped that the same approach can be used to support spray decisions for other diseases and crops.

In 2020, data loggers were placed at trials at Frankland, Gibson, Kojaneerup, and Mount Ridley in WA. A drier than average season was experienced at most sites. According to DPIRD’s Rainfall to Date tool, April to October rainfall was a decile 1 at Gibson (Esperance Downs Research Station), decile 2 at Mount Ridley (Mount Burdett), decile 3 at Kojaneerup, and decile 8 at Frankland. Consequently, the season was not conducive to chocolate spot except at Frankland, which experienced conducive conditions for more than 12 hours in mid-October — a fungicide spray was triggered. Data loggers at other sites received spray warnings at eight hours but did not escalate to spray alerts. Chocolate spot was not observed at these sites.

Figure 8.9: A data logger set-up at the Kojaneerup trial logs environmental conditions hourly via the Telstra narrow-band network. The data are available in real-time online, and the system is programmed to send spray alerts via email.

Ascochyta blight

Ascochyta blight occurs in the medium- and high-rainfall cropping areas but requires cold (<10°C) moist conditions to spread and limit yield. Therefore, ascochyta generally shows up in the winter months or within eight weeks of sowing.

Lifecycle

The pathogen *Ascochyta fabae* releases spores under specific environmental conditions usually occurring in autumn after opening rains and low temperatures (<10°C). Ascochyta can be transmitted through infected seed, though the primary mode of introduction is from infected stubble. Spores may remain viable on infected stubble for two to three years, and most are blown a few hundred metres from their origin. As with chocolate spot, weather is the critical factor determining disease severity. Once spores have blown into the paddock and infection is present in the crop the disease spreads between plants by spores from pycnidia via rain splash and wind. Pycnidia (the fruiting bodies) are visible as black dots in the centre of lesions, making ascochyta distinct from other foliar diseases (Figure 8 6). Spores that land on leaves require leaf wetness (high humidity) for at least 12 hours to infect. Frequent rain events are ideal for ascochyta to spread from plant to plant. If the infection spreads to pods, seed staining can occur, which results in quality downgrades.

Management

- Grow a cultivar with good ascochyta blight resistance (Table 8.2).
- Sow at least 500m away from the previous year's crop
- Sow clean seed
- Monitor the crop frequently, especially in June/July
- Use a fungicide early in the season if conditions are conducive for a disease outbreak or inoculum load is high in the area. If multiple sprays are required, spray ahead of rain fronts and rotate modes of action (Table 8.3)

Cercospora and alternaria leaf spots

Cercospora leaf spot and alternaria leaf spot tend not to cause yield penalties so are not considered severe diseases of faba beans. However, both present as necrotic lesions that reduce green leaf area on the plant and can predispose it to infection by other pathogens, such as chocolate spot. The lesions produced by cercospora and alternaria pathogens look similar and can be very difficult to distinguish (Table 8.1).

Cercospora leaf spot is more likely to be found earlier in the season in winter, as it requires long periods of cold temperatures (7–15°C) and leaf wetness to infect. Cercospora affects the lower half of the plant and as temperatures increase, it can spread rapidly and result in premature defoliation of the lower canopy.

Conversely, alternaria requires warm temperatures (15–20°C) and humidity to infect plants and is more likely to appear later in the season, in spring. It is also more likely to take hold in very wet seasons but is not prevalent in hot, dry springs. Alternaria is considered a secondary pathogen and is more likely to infect plants with existing damage.

Both diseases survive as spores produced on infected crop residues. Alternaria can also survive on infected seed and has many other hosts, though generally control of alternaria alone is not warranted. All current faba bean cultivars are susceptible to cercospora leaf spot, which can be controlled with fungicides, if necessary (Table 8.3).

Rust disease

Rust can be a significant disease of faba beans in the medium- to high-rainfall cropping areas of WA. Unlike those previously mentioned, rusts like *Uromyces viciae-fabae* are biotrophic pathogens. Biotrophs rely on a living host to survive and complete their lifecycle. This makes rust easier to distinguish from other diseases, as it has visible spore masses or pustules that emerge from the plant (Table 8.1) as opposed to necrotrophic lesions. However, rust can still significantly reduce green leaf area and cause premature defoliation, resulting in significant yield loss. Rust likes warm temperatures (>20°C) and at least six hours of leaf wetness, so is normally found in spring. It has a relatively long latency period (10–12 days) before symptoms appear.

Lifecycle

Rust has a complex lifecycle and produces three types of spores at different stages. Early infection appears as creamy-yellow spots that release windborne spores through the paddock and to nearby crops. Orange-brown pustules develop soon after. Late in the season, black spore masses can be seen on stems. These black spores survive over summer on crop residues and initiate disease the following year. Faba bean volunteers over summer and autumn increase the risk of rust outbreaks by increasing spore loads close to seeding. While the major faba bean rust strain is host-specific (*U. viciae-fabae* var. *viciae-fabae*), other strains that infect lentil and vetch can also infect faba beans, so those crops can also facilitate spore production.

Management

- Sow at least 500m away from the previous year's crop
- Control the green bridge, especially pulse volunteers
- Sow clean seed
- Monitor frequently
- Grow a cultivar with good rust resistance. Older varieties like PBA Nanu, PBA Nasma, and PBA Warda are rated resistant–moderately-resistant to rust but susceptible to ascochyta and are omitted from Table 8.2
- Use a fungicide if more than 5% of leaf area is affected by rust before the end of flowering and the yield potential is more than 1.5t/ha (Table 8.3)

Viruses

Four main viruses affect faba beans in WA:

- bean leaf roll virus (BLRV)
- bean yellow mosaic virus (BYMV)
- beet western yellows virus (BWYV)
- pea seed-borne mosaic virus (PSbMV)

All are spread by aphid vectors. These viruses affect yield by reducing the number and size of seeds and PSbMV seed stain reduces seed quality. Unlike fungal diseases that infect locally, virus infections are systemic meaning the entire plant is infected. Symptoms can look similar to nutrient deficiencies, herbicide damage or waterlogging, so the whole paddock situation should be investigated. Virus-affected plants are usually scattered in the crop following aphid movement so note the pattern of affected plants in an area.

Viruses are distinguished by the way they are transmitted by aphid vectors. They are described as persistently or non-persistently transmitted viruses. BLRV and BWYV are persistently transmitted, which means that aphids that feed on infected plants are infectious for the rest of their lives. However, the process of an aphid becoming a persistent vector takes more than one day, so virus spread between plants can be relatively slow. BYMV and PSbMV are non-persistently transmitted viruses, meaning any aphid feeding on an infected plant immediately picks up the virus. An infected aphid can transmit the virus to one or two healthy plants, then the aphid loses the virus from its mouthparts and is no longer a vector (until it probes another infected plant). The process of transmission is relatively fast and more difficult to control with insecticides.

Pea aphids and green peach aphids are effective virus vectors as they tend to colonise plants sparsely and move from plant to plant quickly. Cowpea aphids are inefficient by comparison. Cowpea aphids densely colonise individual plants before spreading through the crop.

Aphids are not the sole vectors of viruses in pulse crops — non-persistently transmitted viruses can also be seed-borne. Persistently transmitted viruses cannot be seed-borne and require a green bridge. Plants grown from infected seed usually exhibit symptoms on all leaves, while in-season infection presents in the young growth only. Virus management includes sowing clean seed, controlling the green bridge, reducing aphid landing rates (e.g. by sowing into standing stubble), as well as using insecticides early to suppress aphids.

Table 8.2: Faba bean variety disease ratings.

Variety	Chocolate spot	Ascochyta blight	Rust	Cercospora leaf spot	PSbMV seed stain
Cairo	S	VS	S	S	-
Farah	S	S	VS	S	S
Fiesta VF	S	S	VS	S	S
Nura	MS	R MR	S	S	VS
PBA Amberley	MR MS	R MR	VS	S	-
PBA Bendoc	S	MR	S	S	S
PBA Marne	S	MR MS	MR MS	S	MR
PBA Rana	MS	MR MS	S	S	MR
PBA Samira	MS	R MR	S	S	S
PBA Zahra	MS	MR MS	VS	S	S

R=resistant, MR=moderately resistant, MS=moderately susceptible, S=susceptible, VS=very Susceptible. PSbMV= pea seedborne mosaic virus.

Sources: NVT Online, NVT Disease ratings (accessed 23/03/2021). www.nvtonline.com.au. DPIRD (2020) 2021 Western Australian Crop Sowing Guide.

Registered fungicides

Table 8.3: Foliar fungicides registered for faba beans in WA at time of publication.

Active ingredient	Product example	Group	Disease	WHP to harvest
Carbendazim	Spin Flo®	1	Chocolate spot	28 days
Chlorothalonil	Barrack® 720	M5	Chocolate spot, rust	14 days
Copper	Blue Shield® DF	M1	Chocolate spot, rust	1 day
Fludioxonil/Pydiflumetofen	Miravis® Star	7/12	Ascochyta blight, sclerotinia, chocolate spot, botrytis rot, cercospora	Not required when used as directed
Mancozeb	Dithane® DF	M3	Chocolate spot, ascochyta blight, cercospora, rust	28 days
Metiram	Polyram® DF	M3	Chocolate spot, ascochyta blight, cercospora, rust	42 days
Procymidone	Prodone® 500 SC	2	Chocolate spot	9 days
Prothioconazole/bixafen	Aviator Xpro®	3/7	Chocolate spot, ascochyta blight, cercospora, rust	N/A*
Tebuconazole	Orius®430	3	Cercospora, rust	21 days
Tebuconazole/ azoxystrobin	Veritas®	3/11	Chocolate spot, ascochyta blight, cercospora, rust	28 days

Always read the label for rates and withholding periods.

**Note: Prothioconazole/bixafen: Withholding period not applicable when used according to label. Do not apply after early flowering (60/61 according to the BBCH-scale).*

Always read the label to check that the specific product being used is registered for planned use before applying. below this add

*** Named products are given as an example of registered products containing the identified active ingredients. This does not imply a recommendation. Other registered products containing the same active ingredient may be available.*

Further reading

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Rhizoctonia patch
at Muradup 2020

9. Managing root pests and pathogens

Carla Milazzo, DPIRD Albany

Key points

- Investigate root health to determine if and what root disease is present, as this affects disease management
- Faba beans are a break crop option for some diseases in a cereal–canola rotation, including some species of root lesion nematode (RLN). There is a lack of knowledge on other species
- Faba beans are a relatively poor host of rhizoctonia bare patch as it prevents the pathogen building up. However, faba beans can still suffer a yield penalty from rhizoctonia infection
- When growing faba beans as a break crop, ensure the crop is clean from weeds that can host root pests and pathogens

Root diseases can be difficult to recognise. They are not always obvious; they can present differently in different seasons or be mistaken for abiotic stresses. Correctly identifying pests and pathogens is essential as it will affect management decisions. Use a shovel to dig up plants, wash roots gently and examine them. It is helpful to wash roots of healthy-looking plants and compare with unhealthy plants. If roots look unhealthy, send samples to the DPIRD Diagnostic Laboratory Service (DDLS) in South Perth for confirmation, or send soil samples to SARDI for PREDICTA® B DNA analysis.

Root diseases can be difficult or impossible to control in-season, so the best way to manage them is to reduce the risk of infection by managing inoculum and disease pressure with cultural strategies. Crop rotation, time of sowing, seed treatment, crop nutrition, weed control, cultivation and farm hygiene are all factors growers can consider to manage root disease.

Faba beans as a break crop

Consider the effect of root disease on the current crop as well as subsequent crops. Like other broadleaf crops, faba beans are good break crops for cereal diseases including crown rot, take-all, cereal cyst nematode, charcoal rot, and common root rot. Faba beans can also host some diseases like RLN without showing symptoms or suffering a yield penalty. Thus, it is necessary to distinguish between 'resistance' and 'tolerance' with respect to root disease.

Tolerance refers to the effect the pathogen has on yield (Table 9.1). If faba beans are tolerant of a pathogen, yield loss is likely to be low even if the plant is infected. Resistance or susceptibility refers to the effect of the crop on the pathogen. If faba beans are resistant to a pathogen, they are not a viable host and the pathogen inoculum load declines. If faba beans are susceptible, they are a good host and the pathogen multiplies. For example, faba beans are intolerant to rhizoctonia root rot (suffer a yield penalty) but are relatively resistant (reduce inoculum load).

The data in Table 9.1 is based on trials conducted in eastern Australia and does not necessarily apply to WA; it should be used with caution in a WA context.

Table 9.1: Interactions between root diseases and faba bean plants.

Disease		Effect on crop yield	Effect on pathogen
Root lesion nematode *(Pratylenchus)*	*P. neglectus*	Tolerant	Resistant
	P. quasitereoides	Data lacking	Data lacking
	P. penetrans	Data lacking	Data lacking
	P. thornei	Tolerant	Susceptible
Rhizoctonia root rot		Intolerant	Resistant
Phytophthora root rot		Tolerant	Resistant
Fusarium root rot		Tolerant	Susceptible
Pythium root rot		Tolerant	Data lacking

Root lesion nematodes

RLNs are microscopic worm-like parasites that infect and damage plant roots and cause yield loss by restricting the plant's ability to take up water and nutrients from the soil. They have a broad host range including cereals, oilseeds, pulses, pastures, and broadleaf and grass weeds. They are generally concentrated in the top 10cm of soil and over summer can dehydrate in dry soil and roots, reactivating after rain. In WA, RLN can complete three to six generations within a growing season with a susceptible host.

Several species of RLN in the genus *Pratylenchus* cause yield loss in broadacre crops in WA. These are *Pratylenchus neglectus, P. quasitereoides* (formerly called *P. teres*), *P. thornei*, and *P. penetrans*. RLN are present in 80% of WA paddocks; multiple species can be present. In about half of these RLN-infested paddocks, RLN numbers are believed to be yield-limiting. The extent of yield loss is directly related to the population density of RLN present in the soil at sowing.

NOTE: Limited knowledge exists on the effect of RLN on crops other than cereals — almost all research conducted in WA has been on cereals.

Identification

Root symptoms are first observed six to eight weeks after sowing. In cereal paddocks, symptoms appear as wavy, uneven and patchy crops that can be chlorotic and stunted. When affected plants are pulled up, their roots will contain brown lesions, lack lateral roots and root hairs, and will have lost some of the outer root sheath. As a result, above-ground symptoms can present as water stress or nutrient deficiency. Similar symptoms are observed in broadleaf crops due to root damage and poor root growth. Species of RLN can only be distinguished in a laboratory using either a microscope (DDLS) or with molecular methods (PREDICTA® B).

The most widespread species in the WA wheatbelt is *P. neglectus*. Under high population densities and in conducive seasons, *P. neglectus* can cause yield losses of 20–40% in intolerant cereals. *P. thornei* is common to cropping regions in eastern Australia, and although it does occur in WA, it is not believed to be as damaging. *P. quasitereoides* has only been found in WA. The host range and yield impacts of this species on various crops is still under investigation. All species of RLN have a broad host range; however, nematodes can multiply on different crops to varying degrees (Table 9.1 Figure 9.1: Rhizoctonia bare patch causing distinct spear-tipping on faba bean roots near the soil surface 1). For example, faba beans are resistant to *P. neglectus*, but may allow *P. quasitereoides* to multiply; therefore, it is important to determine which species of RLN is present when planning the best rotation strategy.

Faba beans an effective break crop for RLN (*Pratylenchus neglectus*)

Glenn and Tara Ball and agronomist Garren Knell (ConsultAg) noticed areas of poor cereal growth on Glenn's Dumbleyung farm about eight years ago. Cereal crops would germinate well but at the four to five leaf stage when the weather cooled, some patches would stop growing and only produce one tiller. After sending a few plants to DDLS, high numbers of RLNs were discovered, both *P. quasitereoides* and *P. neglectus*. These populations were distinct from each other in different parts of the paddock.

Over the years, Glenn and Garren have noted the following from their experience:

- Growing canola increased RLN damage on the following cereal crop
- Placing compound fertiliser away from the seed seemed to increase RLN damage
- Wheat seemed more susceptible than barley

In 2017, DPIRD ran a nutrition trial at Glenn and Tara's farm to investigate the effect of N rate on RLN damage in wheat (cv. Mace). Results showed that increasing N produced higher yields and protein, thus providing higher returns; however, increasing N also increased RLN numbers. This was likely due to greater root biomass being available for nematodes to feed on. Although higher returns were observed in the short term, there may be consequences to susceptible crops grown in the future.

In 2018, DPIRD conducted a small-plot break crop trial on the farm to compare *P. neglectus* populations in response to lupin, faba bean, serradella, and canola. RLN numbers were measured under wheat in 2019 and oats in 2020 to see how fast the population increased after a break crop. Although faba bean, lupin, and serradella reduced RLN numbers by about half in the break crop year, numbers doubled under canola. After the break crop year, wheat and oats enabled RLN multiplication and increased the population back to its pre-break crop levels by 2020, regardless of whether canola or a legume break crop had been grown.

Glenn sows PBA Samira faba beans in paddocks that have moderate to high RLN numbers and feels positive about the benefits faba beans offer his system.

See Section 12 for full details of this grower's methods.

Management

RLN numbers build up in the soil from intensive cropping of susceptible crops like canola and cereals, especially wheat. Eradication is not possible, so the goal is to suppress nematode numbers to levels that do not reduce yield. The best way to manage RLN is to grow a healthy weed-free crop (or variety) that is a poor host to the dominant RLN species in the paddock. Faba beans are tolerant and resistant to *P. neglectus* (Table 9.1). Faba beans restrict nematode multiplication, but depending on the starting levels of RLN, more than one consecutive break crop may be required, or a chemical fallow and a break crop. There should be significantly fewer *P. neglectus* nematodes in the soil following a faba bean crop compared to canola or cereals.

P. quasitereoides only causes problems in WA and trials have not yet been conducted. It is not known whether faba beans are susceptible or resistant to *P. quasitereoides*. Similarly, trials have not been carried out on *P. penetrans* in WA (Table 9.1).

Trials conducted by DPIRD have shown that other legumes (including faba beans, lupins, and serradella) are effective break crops for RLN only if they are weed-free. Canola is not an effective break crop for RLN in cereal cropping programs.

If growing a susceptible crop, minimise yield loss from RLN by sowing the most resistant cultivar and applying adequate nutrition. Although adequate nutrition allows plants to better tolerate RLN, it does not reduce nematode density in the soil. DPIRD conducted a trial in wheat to investigate whether N fertilisers that release ammonium ions are toxic to RLN. However, higher urea rates increased RLN populations, most likely due to the larger root biomass grown. Research conducted in eastern Australia suggests that early sowing is another tactic to minimise yield loss from RLN, though this has not yet been studied in WA.

It is critical that growers manage weeds in break crops, especially those weeds that are good hosts for RLN, such as ryegrass, brome grass, barley grass, wild oats, and wild radish. No nematicides are currently registered in broadacre cropping for the control of nematodes.

Rhizoctonia

The fungus *Rhizoctonia solani* that causes rhizoctonia bare patch in cereals and lupins also causes disease in faba beans. Despite this, faba beans are a relatively poor host of rhizoctonia as they prevent the pathogen building up in the soil. To get the best disease break from growing faba beans, ensure the paddock is free of weeds, especially grasses. Rhizoctonia is well adapted to dry conditions and thrives in soils with poor fertility and low microbial activity, such as sandy and sandy loam soils. It survives over summer mostly in the top 3cm of soil on crop residues. Moist topsoil over summer encourages the fungus to break down, while dry conditions allow it to survive in a dehydrated state. After the season break, the fungus begins to grow and form a hyphal network in the top 5cm of soil.

Identification

Symptoms of rhizoctonia in faba beans are similar to the symptoms in other crop types. Young seedlings are infected after rain. Four to six weeks after sowing, stunted or dying plants appear in round patches up to 5m in diameter. The roots show blackening and distinct spear-tipping caused by the outer root cortex decaying (Figure 9.1). There may also be reddish-brown lesions on the roots. Cool soil temperatures in winter slow the disease down but affected patches can yield nothing.

Figure 9.1: Rhizoctonia bare patch causing distinct spear-tipping on faba bean roots near the soil surface.

Management

Rhizoctonia bare patch is difficult to manage due to its broad host range. Dry summers and dry starts increase the risk of yield loss. Seed treatments or liquid banding of fungicides in-furrow and/or behind the press wheel can help protect cereals; however, fungicides near the seed are not recommended for faba beans due to potential interactions with rhizobia. Tillage practices that disturb inoculum in the top soil (such as cultivation 10–15cm deep immediately before sowing or sowing with knifepoints) and sowing early may delay seedling infection but only by a few weeks. Crop rotation and early green bridge control reduces inoculum load. Grass weeds are good hosts to rhizoctonia; therefore, it is critical that break crops like faba beans or canola are weed-free. Chemical fallow is an option where growing season rainfall can help decompose fungal hyphae in the absence of host plants.

Other root rots

Root rots caused by fungi in the genera *Pythium*, *Fusarium*, and *Phytophthora* can affect faba beans. Broadleaf crops can support larger populations of these pathogens than cereals. Root rots are generally associated with periods of waterlogging or poor drainage. They are generally minor diseases in WA's rain-fed systems; they are more problematic in cropping systems in eastern Australia that rely on stored soil moisture to grow and in soil types with high organic matter. However, these fungi can predispose plants to infection by other pathogens, causing disease complexes like pythium-rhizoctonia and pythium-fusarium. Depending on the pathogen, the disease primarily spreads between and within paddocks by windborne spores, and to a lesser extent by contaminated soil carried on machinery and livestock. Moisture is required for infection to occur.

Identification

Infection can occur at any growth stage. Affected seedlings blacken from the base upwards and lose leaves, wilting and eventually dying or 'damping off'. The roots of established plants can also blacken, lack lateral roots and show signs of rotting. Brown or black lesions may be visible on the roots. When plants are pulled up, tap roots can be brittle and snap off, remaining in the ground. In the case of pythium root rot, the roots become soft instead of brittle.

Management

Crop rotation is the primary management tactic — although host ranges may be diverse, there are crops and cultivars with lower susceptibility. For example, cereals, specifically barley, are less susceptible to pythium than faba beans. Faba beans are relatively tolerant of waterlogging but the risk of root rot increases in prolonged wet conditions. Take measures to improve drainage where possible. Fungicidal seed dressings can be used, though this is not common practice with faba beans as they can reduce rhizobia viability and compromise nodulation.

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10. Minimising harvest loss

King Yin Lui, DPIRD Esperance

Key points

- Do not desiccate too early. Desiccating the crop before it is mature can easily downgrade the sample because of wrinkled and defected grain
- Harvest early once pods are brown to black, before stems and pods are too brittle, and not during hot harvest conditions to minimise losses from the header front
- Faba beans are prone to damage from mechanical handling occurring during harvesting, transferring and transporting grain
- Store and transport grain between 10% and 12% moisture and for no longer than six months to minimise colour change and mechanical damage

Desiccation timing – colour change

Desiccation should be timed for when the seed 'scar' (the hilum where the seed attaches to the pod) changes colour from yellow to dark brown and the seed comes away from the pod easily (Figure 10.1). The decision of when to desiccate can be complicated by uneven maturity of pods on a given plant and across the paddock. Timing of desiccation should be when 90–95% of grain has reached maturity to minimise yield loss and maintain grain quality (Figure 10.2). Current guidelines say to time desiccation based on the maturity of the top 25% of pods or when all pods are fully filled and lower pods are black in colour.

Figure 10.1: Faba beans are ready to harvest when the hilum turns black and detaches from the pod.

Figure 10.2: Desiccate when at least 90% of pods are ready to harvest.

Reducing harvest losses off the header front in the Esperance port zone 2020

Hot, dry harvest conditions can increase pod drop, shattering and mechanical damage. Lee Hallam farms in Grass Patch and had noticed an increase in shattering and pod drop at the cut height when harvesting during the hottest time of day. He observed that picking the harvest timing and conditions can make a difference of almost 100kg/ha of grain lost or harvested. In a survey of losses from the 2020 harvest on a paddock with a heavy soil type that was rolled post-seeding, an average loss of 240kg/ha occurred in an area harvested when cool, and 323kg in an area harvested when hot. A dry autumn meant low biomass and pods set low in the canopy. In comparison, a nearby paddock with a sandier soil type that was not rolled had better early biomass and higher pod-set and had losses of 97kg/ha.

Rohan Marold runs both a CASE draper and tin front. He prefers the tin front as it allows him to go faster on the coastal farm in Dalyup and he has observed fewer losses on other crop types from this front. In a comparison between the two setups during the 2020 harvest, losses were, on average, 65kg/ha less from the tin front compared to those from the draper front.

Mark Wandel, a long-time faba bean grower in Scaddan, uses flex draper fronts on rolled paddocks and wide row spacing (75cm). This set-up allows him to cut low and feed in high biomass crops to minimise losses off the front. He prefers to use the draper fronts to harvest faba bean, as opposed to an air-reel type front that has trouble feeding the tall crop into the header. The Wandels harvest faba beans before they get too dry and brittle and are tactical in planning crop-topping and desiccation herbicides. They still believe too many end up on the ground, estimating up to 200–300kg/ha in grain losses.

See Section 12 for full details of each grower's methods

Figure 10.3: Pods and grain left in the paddock at Grass Patch.

Harvest timing to prevent pod losses and maintain grain quality

Faba beans should be harvested early, before stems and pods get too brittle. Yield losses from delayed harvest occur from pod splitting, pod drop and lodging after the crop has dried down. Weathering in the paddock and exposure to rain during the harvest period can quickly cause grain to darken and result in a loss of quality.

Aim to achieve 12–14% moisture to maximise grain weight and reduce risk from mechanical damage. Moisture below 10% increases the risk of mechanical damage during handling. However, storing faba beans above 12% moisture can cause the colour to darken more quickly.

Grain defects from desiccating too early and delaying harvest

Observations from Neil Wandel (owner) and Daryl Gifford (manager) from Esperance Quality Grains is that one of the main causes of wrinkled grain is from early desiccation from growers compromising crop-topping for desiccation to control weed seed-set. They have observed that when pulses are left too long after desiccation, particularly after rain events, darkening of grain can occur, which downgrades the sample. They said it is easy to go from No. 1 to No. 2 grade and that they see a wide spectrum of grain qualities at grade No. 2.

They recommend that beans are stored for no more than seven months using any method (e.g. bags, silos, sheds). Beans change colour when they are stored for long periods in warm, moist conditions.

Figure 10.4: Faba bean quality and common defects delivered to Esperance Quality Grains

A. Farmer-dressed No. 1 faba bean sample.
B. Farmer-dressed No. 2 faba bean sample.
C. Discoloured grain. D. Wrinkled grain.

Photos courtesy of Daryl Gifford, Esperance Quality Grains.

Minimising mechanical damage

Faba beans are prone to mechanical damage from over-threshing and rough handling. They thresh easily so drum or rotor speed should be adjusted to 300–600rpm and concave clearance increased to 15–25mm. Remove every second wire in the concave so grain separation can occur at the concave. Increase the concave clearance if seed is being cracked and increase the drum speed if seed is left in the pods.

Further reading

Receival and trading standards, Pulse Australia
http://www.pulseaus.com.au/marketing/receival-trading-standards

Emma Pearse
at Scaddan, 2020

11. Calculating the value of faba beans

King Yin Lui, DPIRD Esperance
Carla Milazzo, DPIRD Albany

Key points

- Faba beans can be at least as profitable as canola in the year sown, especially if you can take advantage of high prices
- The rotational value of faba beans can be estimated in the year they are sown by adding the value of N fixed and the value of the yield advantage in the following crop to the return from faba beans. The actual rotational value of faba beans depends on seasonal conditions

Break crop profitability

Although the rotational benefit of pulses is largely understood, they are often not considered profitable in their own right and their rotational value is difficult to account for. This Section presents an example gross margin comparing faba beans to canola in the year of production as well as a worked example of how to estimate the rotational value of pulses.

Case studies of faba beans grown in the high-rainfall zone at South Stirling and in the medium- to low-rainfall zone at Grass Patch highlight that, under average prices, they can compete with canola in the year sown (Table 11.1). Although high prices in 2017–2018 ($900/t to $1200/t) were a strong incentive to grow faba beans, it is more useful to use a long-term average price when deciding whether to sow faba beans. Therefore, a five-year (2016–2020) average price of $477/t was used in Table 11.1. Pulse prices are notoriously volatile and in the 10-year period from 2010 to 2020, annual average prices delivered to Fremantle ranged from $330/t to $926/t (data supplied by Pulse Australia). Table 11.2 demonstrates the sensitivity of faba bean gross margins to a range of yields and prices.

The production costs for faba beans are generally lower than canola by $30–50/ha, because less fertiliser is used. The South Australian Department of Primary Industries and Regions (PIRSA) ‘2020 Farm Gross Margin and Enterprise Planning Guide’ is a useful resource to benchmark various crops and is comparable to WA south coast farming systems.

The South East Premium Wheat Growers Association (SEPWA), in partnership with the Pulse Association of the South East (PASE), undertook a series of projects to investigate pulse supply chains, marketing opportunities, and containerisation of pulses. Growers in Esperance now have the option to market pulses locally, which has helped overcome market access barriers and reduced exposure to high transport costs. Contact PASE or SEPWA for more information.

Table 11.1: Gross margin of faba beans grown in high-rainfall (South Stirling) and medium- to low-rainfall (Grass Patch) zones in 2019, during a below average rainfall year, compared to standard costs.

		High-rainfall zone (HRZ)			Low-rainfall zone (LRZ)		
		Faba bean		TT-Canola	Faba bean		TT-Canola
		South Stirling	Standard HRZ	Standard HRZ	Grass Patch	Standard LRZ	Standard LRZ
Yield	t/ha	2.4	2.4	2.0	0.8	0.8	1
Price – 5 year average	$/t	477	477	549	477	477	549
Gross income	**$/ha**	**1145**	**1145**	**1097**	**382**	**382**	**384**
Freight and selling	$/ha	130	111	79	16	25	28
Seed and fertiliser	$/ha	222	180	213	103	87	105
Crop protection	$/ha	151	180	194	50	101	133
- *Herbicide*	$/ha	120	100	106	32	77	106
- *Fungicide*	$/ha	27	72	40	15	15	
- *Insecticide*	$/ha	4	9	48	3	9	27
Soil amelioration annualised	$/ha	22	22	22			
Operations and insurance	$/ha	83	80	126	78	46	44
Total variable costs	**$/ha**	**608**	**573**	**634**	**247**	**259**	**310**
GROSS MARGIN	**$/ha**	**537**	**572**	**463**	**135**	**123**	**74**

Annual rainfall zones are classified as high (>400 mm), medium (350–400 mm), and low (<350 mm).
TT-canola refer to Triazine tolerant canola.
Annualised soil amelioration costs take into consideration the cost of liming and deep ripping on south coast sandplain over ten years.

Source: Adapted from: PIRSA (2020) Farm Gross Margin and Enterprise Planning Guide.

Table 11.2: Sensitivity of faba bean gross margin ($/ha) to variations in yield and price, based on a variable cost of $608/ha, as in the South Stirling example gross margin above.

Yield (t/ha)	Faba bean price ($/t)					
	$300	$400	$500	$600	$700	$800
1.0	-$308	-$208	-$108	-$8	$92	$192
1.2	-$248	-$128	-$8	$112	$232	$352
1.4	-$188	-$48	$92	$232	$372	$512
1.6	-$128	$32	$192	$352	$512	$672
1.8	-$68	$112	$292	$472	$652	$832
2.0	-$8	$192	$392	$592	$792	$992
2.2	$52	$272	$492	$712	$932	$1,152
2.4	$112	$352	$592	$832	$1,072	$1,312
2.6	$172	$432	$692	$952	$1,212	$1,472
2.8	$232	$512	$792	$1,072	$1,352	$1,632
3.0	$292	$592	$892	$1,192	$1,492	$1,792

Rotational benefit from pulses

As discussed in earlier Sections, the greatest N benefit from faba beans comes from the reduction in fertiliser N required for the crops that follow faba beans. Aside from the dollar value of N, faba beans provide a break from root diseases and offer alternative weed management options. The value of these benefits is difficult to quantify but can be observed for multiple years after the break crop.

As part of the GRDC project, SEPWA conducted a two-year field demonstration, ('Legumes for profitability in the Esperance port zone'), which demonstrated the rotational value of faba beans compared to canola and a subsequent wheat crop. The wheat yield increased by approximately 300 kg/ha following faba beans, compared to canola. Soil at the site was acidic (pH($CaCl_2$) 4.6–5.5) at 0–30cm, which may have constrained faba bean growth. Protein level (10.35%) in wheat after faba beans compared to wheat after canola, was not enough to meet higher wheat grades and grain price. Although the wheat crop was more profitable following faba beans, the overall result was a $315/ha decrease in net revenue in the faba bean–wheat sequence compared to canola–wheat in these seasons (Table 11.3).

The yield and protein response to added N depends on seasonal conditions. Therefore, when budgeting to grow faba beans, their rotational value can be accounted for in the year sown by including the value of added N and the value of the yield advantage to the following wheat crop to faba bean returns. The value of N fixed is calculated based on the assumption that one tonne of faba bean yield provides 29kg of N. The yield advantage gained in wheat after faba bean is about 30% of the pulse yield in wheat grain value. Using the results from the SEPWA demonstration trial, 61kg/ha of N was estimated to be added from faba beans, valued at $76/ha; applied as Flexi-N at $450/L (32% N) or $1.40/kg N, and $149/ha added wheat value (Table 11.3).

Figure 11.1: Greg Warren (Farm and General EOPP, Esperance) and Mark Seymour (DPIRD) presenting at the Esperance Downs Research Station field walk in 2018 at the SEPWA pulse demonstration site.

Table 11.3: Rotational value of faba beans before wheat compared to canola before wheat.

Value of rotation from SEPWA break crop demonstration trial at Gibson (2018–2019)					
		Faba beans–wheat rotation		Canola–wheat rotation	
		Faba beans	Wheat after beans	Canola	Wheat after canola
Yield	t/ha	1.71	4.94	2.17	4.63
Protein	%		10.35		9.88
5 year price average	$/t	477	290	549	290
Gross income	**$/ha**	**816**	**1433**	**1190**	**1343**
Freight and selling	$/ha	74	144	89	141
Seed and fertiliser	$/ha	177	176	160	176
Crop protection	$/ha	162	127	140	127
Operations	$/ha	147	147	147	147
Total variable costs	**$/ha**	**560**	**594**	**533**	**591**
GROSS MARGIN	**$/ha**	**256**	**839**	**657**	**752**
Fixed costs	$/ha	170	170	170	170
Total operating cost	**$/ha**	**730**	**764**	**703**	**761**
NET MARGIN	**$/ha**	**86**	**669**	**487**	**582**
2 year net margin	**$/ha**	**754**		**1069**	
Estimated rotational benefit of beans calculated in pulse crop year					
Nitrogen value	$/ha	70		29kg N per 1t of pulse yield, valued at $450/L Flexi-N (32% N)	
*Yield benefit of wheat following pulses	$/ha	149		= 30% of pulse yield × $wheat price = 0.513 × $290/t	
Total estimated benefit		**219**			
Profit with rotational benefits	**$/ha**	**304**		**487**	
Value of faba bean relative to canola	**$/ha**	**-183**			

** The actual response and value of added N will depend on seasonal conditions that determine the yield and quality response.*
Data from the SEPWA demonstration site in Gibson.
Break crops were sown in 2018 and wheat in 2019.

Summary

On average, faba beans are less profitable than canola in the rotation despite the N and yield benefit to the following crop. As the yield potential of cereals and canola increases with improved varieties, crop protection and soil amelioration, extra pressure is put on the long-term sustainability of the rotation, especially in the face of declining cereal protein, pesticide and herbicide resistance, and disease/pest build-up. Therefore, faba beans, and pulses in general, have an important part to play in the farming system. Growers need to budget for them accordingly, take advantage of high prices, and consider their long-term agronomic advantages to capture the most value from them.

Further reading

Department of Primary Industries and Regions, South Australia (PIRSA) (2020) 2020 *Farm Gross Margin and Enterprise Planning Guide: A gross margin template for crop and livestock enterprises* [online document], accessed 27 January 2021. https://grdc.com.au/FarmGrossMarginGuide

South East Premium Wheat Growers Association [website], accessed 27 January 2021. https://www.sepwa.org.au/

King Yin Lui
at Gibson, 2020

12. Grower case studies

Regional Agronomy Team

Throughout 2020, DPIRD's Regional Agronomy Team surveyed 15 faba bean paddocks across the south coast region — from Kojonup in the west, north to Dumbleyung and across to Beaumont in the east. The team interviewed growers who have been producing faba beans for two to 17 years and have collated their experiences, tips, and tricks for successful faba bean production.

DPIRD thanks those growers for their input into this Section.

> These case studies report on practices that growers use to manage pests, weeds and diseases. Before applying any crop protection product read the label, ensure that is registered for planned use and apply in accordance with label directions for use.

Joel Johnstone, Carla Milazzo, Dave Cook (Warakirri Cropping), Jeremy Lemon and King Yin Lui at Condingup, 2020.

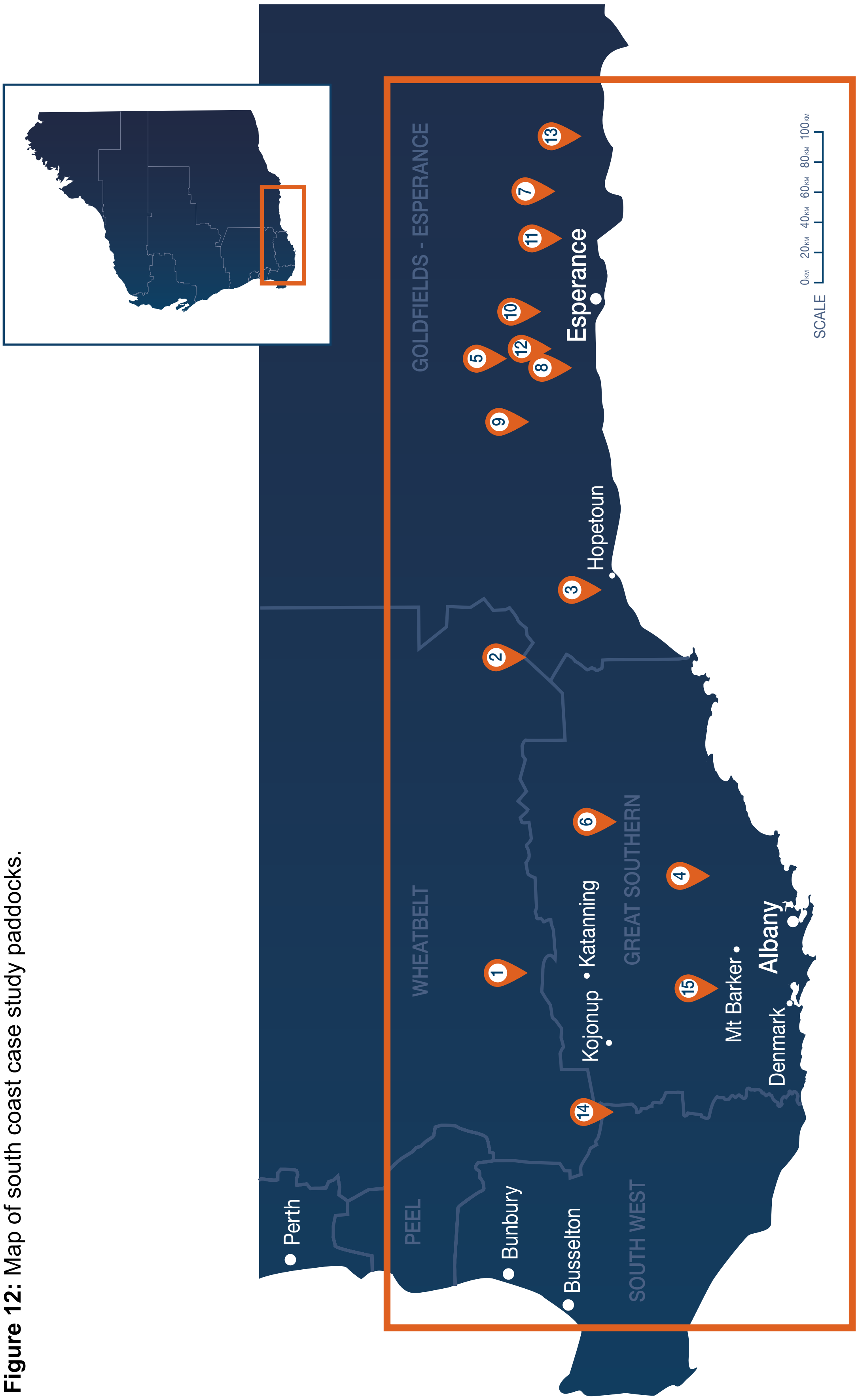


Figure 12: Map of south coast case study paddocks.

Table 12.1: Faba bean production summary (2020) from 15 growers surveyed and interviewed in southern WA.

Map reference	Grower	pH ($CaCl_2$) 0-10cm	Soil type	Variety	Inoculant	Sowing date	Row spacing (cm)	Sowing rate (kg/ha)	Yield (t/ha)	GSR (mm)
1. Dumbleyung	Ball	5.5–6	Loamy-gravelly sand, red loam	PBA Samira	Easy-RhizTM	15 April	25	110	1.2–1.4	210
2. West River	Burrell	5.3-6.9	Sandy loam to loam	PBA Samira	Peat (double)	16 April	25.4 (10inch) Skip third row	100	1.8	206
3. Hopetoun	Foulds	5–6.5	Sandy loam to loamy clay	PBA Samira	Peat	8 April	25.4	130	1.7	250
4. Kojaneerup	Goad	5.5–6	Pale deep sand, deep sandy duplex	PBA Samira	ALOSCA®, peat	28 April	25	200	1.7	230
5. Grass Patch	Grass Patch grower	6.5	Sand to loam	PBA Samira	Peat		25.4 (10inch)	100	0.7	145
6. Ongerup	Harding	5	Grey sand over clay	PBA Samira	Nodulator granules	28 April	75	140	2.3–2.4	220
7. Beaumont	Mansell	5.5–7	Sandy loam to loamy clay	PBA Samira	Peat - Green Rhiz	8 April	25.4 (10inch)	100	2.5	284
8. Dalyup	Marold	5	Sand to loam	PBA Samira	ALOSCA®	10 April	25.4 (10inch)	80	2.4	389
9. Coomalbidgup	Marshall	6–7	Sandy loam to loamy clay	PBA Samira	ALOSCA®	30 April	30	100	0.9	185
10. Scaddan	Morcombe	5.1–8	Sandy loam to loamy clay	PBA Samira	Peat	3 April	30	120	2.1	205
11. Condingup	Perks	6	Sand	PBA Samira	ALOSCA®	20-25 April	30	100	1.0	240
12. Scaddan	Wandel	6	Loam	PBA Samira	ALOSCA®	10 April	75	150	2.2	225
13. Condingup	Warakirri	5.2–6	Sand to loamy clay	PBA Samira	ALOSCA®	27 May	27.9 (11inch)	100	2.8	281
14. Muradup	Webb	5.1–5.9	Forest gravel	PBA Bendoc	ALOSCA®, Easy-RhizTM	2 May	22.9 (9inch)	140	2.5	305
15. Kendenup	Wood	5–6	Gravelly loam, clay loam	PBA Samira	Peat	3 May	35.6 (14inch)	140	2.9	330

GSR = growing season rainfall

2020 season summary

The area sown to faba beans has increased dramatically in recent years. Planned plantings in 2020 were 21,383ha of faba beans in WA, according to data collected by CBH. This is a large increase from planned state-wide plantings of 15,568ha in 2019 and 2,331ha in 2018.

The 2020 growing season was drier than average across most of southern WA, with large areas experiencing a decile 2–3 year. Southern coastal parts of the Albany port zone had a particularly dry winter with no significant rainfall events (over 10mm) from the season break (6 May) until August, when some growers reported more than 100mm in 24 hours, and then had waterlogging issues. Southern parts of the Esperance port zone experienced a season break around 19 April, while this was later and more variable moving inland. Despite this, crops displayed excellent water-use efficiency with pulse yields exceeding Grain Industry Association of WA (GIWA) estimates.

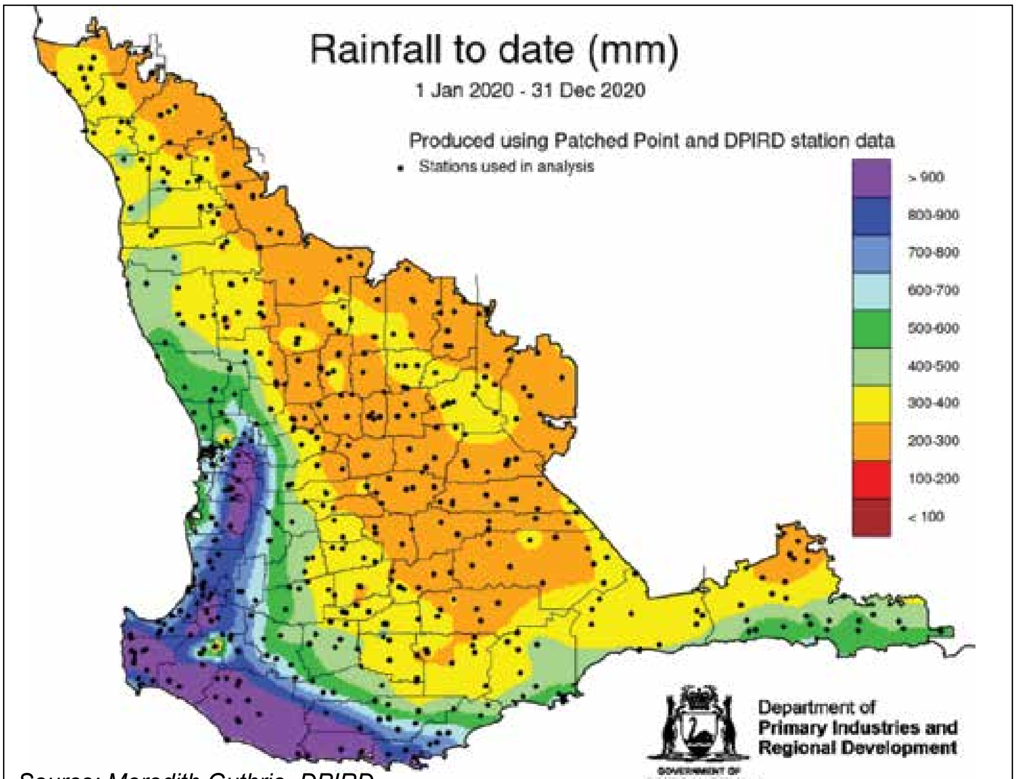
The 2020 season was also made challenging by strong winds across the south coast early in the season. Faba beans were less affected by these wind events than other crops. Their large seed size gives them the ability to emerge from depth, meaning furrow-fill was not a problem and good establishment was observed.

Other observations from the 2020 surveys include:

- most crops were sown dry in April
- PBA Samira was the main variety sown
- plant numbers were generally lower than the recommended 30 plants/m^2
- canola, capeweed, and wild radish were the most common broadleaf weeds. A dry summer and dry sowing meant early weed control was not optimal, so these weeds were harder to control later in the season
- early drought stress increased pressure from cowpea aphids
- foliar disease was not widely reported east of Albany Highway due to the dry, windy spring
- hot, strong winds in September (Esperance region) affected pod-set with many growers observing flower abortion and low harvest index. Winds later in November caused necking in some paddocks where crops were tall and thin

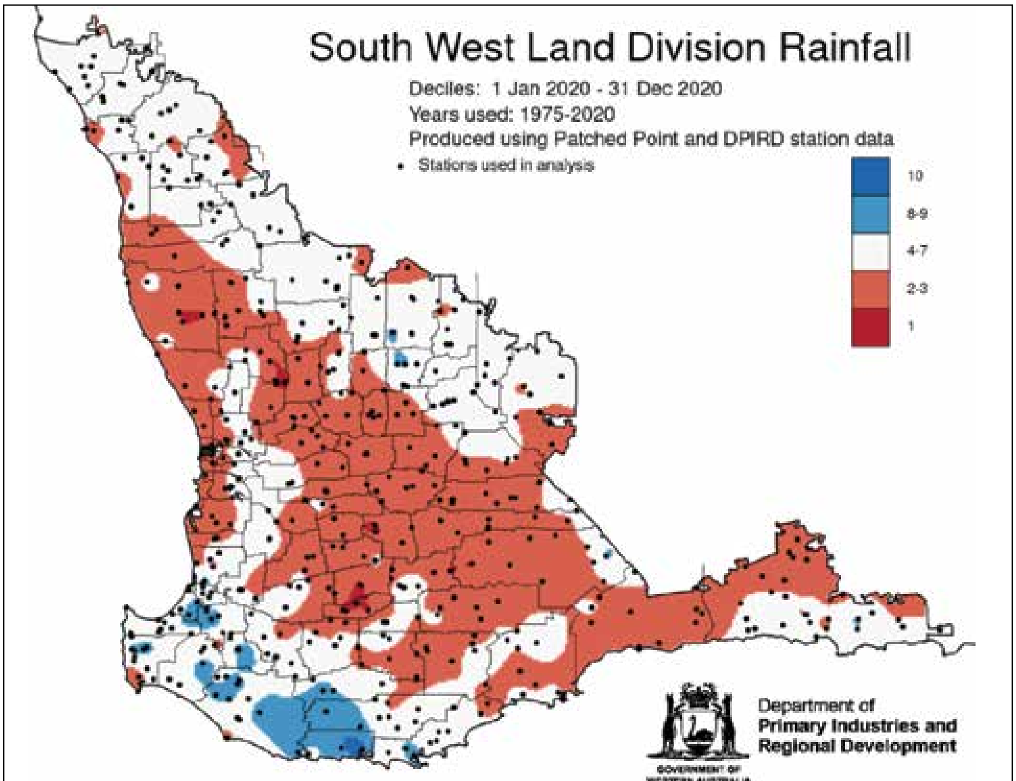
Lupin prices were good and faba bean prices were low — at the end of a difficult bean growing season, many growers are interested in lupins again, though still optimistic about beans. Due to low prices, growers are looking to store beans on farm, where possible. Price and seasonal condition fluctuations are a good reminder of the benefits of a diverse crop rotation.

Figure 12.2: Annual rainfall 2020.



Source: Meredith Guthrie, DPIRD

Figure 12.3: Annual rainfall deciles 2020.



Source: Meredith Guthrie, DPIRD

Ball – Faba beans a break crop for root lesion nematodes at Dumbleyung

Carla Milazzo, DPIRD Albany

SNAPSHOT

Growers: Glenn and Tara Ball
Location: Dumbleyung
Enterprises: 70% crop (wheat, barley, oats, canola, beans, lupins), 30% pasture for sheep
Growing season rainfall: 250–300mm (2020: 210mm)
Years growing beans: 2
Typical rotation: Wheat, barley/oats, broadleaf (beans/canola/lupins)

Paddock set-up 2020

Soil type (pH, texture)	Loamy sands, gravelly sands, red loams pH($CaCl_2$): Topsoil 5.5–6, more alkaline at depth (up to ~6.5)
Variety	PBA Samira
Seeding rate	110 kg/ha
Row spacing	25.4 cm (10 inch)
Seeding date	Dry sown on 15 April (opening rains 5 May)
Seeding set-up	13.7 m (45 ft) DBS, double chute for seed and fertiliser
Inoculant	EasyRhizTM through liquid system
Nutrition at seeding	60 kg/ha Agflow (CSBP)
Broadleaf herbicide strategy	Pre-seeding knockdown, pre-emergent Terbuthylazine (e.g. Terbyne®) Grows following a cereal so the paddock is cleaner. Hand weeding wild radish. Crop-topping and chaff lining.
In-season nutrition	None

2020 in-season management

	Target	Input
Fungicides	Chocolate spot	Mancozeb and Veritas® (tebuconazole + azoxystrobin) during flowering
Insecticides	Budworm	Not required
Desiccation/Crop-topping	Ryegrass and wild radish	Paraquat

Faba beans an effective break crop for RLN *(Pratylenchus neglectus)*

Glenn and Tara Ball and agronomist Garren Knell noticed areas of poor cereal growth on the Ball's Dumbleyung farm about eight years ago. The cereal crop would germinate well but at the four to five leaf stage when the weather cooled, some patches would stop growing and only produce one tiller.

Glenn had been windrow burning since the early 2000s and recalls that the crop sown into the windrows looked remarkably healthier than between the windrows, where the crop appeared water- or nutrient-stressed. Applying more fertiliser did not seem to help. After sending a few plants to DDLS, high numbers of RLN were discovered, both *Pratylenchus quasitereoides* and *P. neglectus*. These populations were distinct from each other in different parts of the paddock.

Over the years, Glenn and Garren have noted the following from their experience:

- Growing canola increased RLN damage on the following cereal
- Placing compound fertiliser away from the seed seemed to increase RLN damage
- Wheat seemed more susceptible than barley

In 2017, DPIRD ran a nutrition trial at the Ball's farm to investigate the effect of N rate on RLN damage in wheat (cv. Mace). Results showed that increasing N produced higher yields and protein, thus providing higher returns; however, increasing N also increased RLN numbers. This was likely due to greater root biomass being available for nematodes to feed on. Although higher returns are observed in the short term, there may be consequences to susceptible crops grown in the future.

In 2018, DPIRD conducted a small-plot trial on the farm to compare RLN (*P. neglectus*) populations in response to lupin, faba bean, serradella, and canola crops. RLN numbers were measured under wheat in 2019 and oats in 2020 to see how fast the population increased after a break crop. While faba beans, lupins, and serradella approximately halved RLN numbers in the break crop year, numbers doubled under canola. After the break crop year, wheat and oats enabled RLN multiplication and increased the population back to pre-break crop levels by 2020, regardless of whether canola or a legume break crop had been grown.

Glenn trialled paddocks of faba beans in 2019 and 2020, sowing PBA Samira faba beans in paddocks that have moderate to high RLN numbers. The faba beans are fitting well into areas with more gravel, loam and clay content in country where lupins do not perform so well. Glenn increased the area of faba beans sown from 50ha to 300ha in 2020. Although frosts and dry finishes have reduced yield, paddock averages ranged from 1.2–1.4t/ha in 2020, with yields up to 2t/ha in 2019 on heavier soil types. After faba beans the numbers of RLN in the topsoil have declined compared to pre-seeding levels but were still at moderate levels where ryegrass control was poor.

Glenn feels positive about the benefits that growing faba beans offers his system. Although they cost him about the same as canola to grow, faba beans offer the added benefit of fixing N and are resistant to RLN. He says that if beans yield 1.5t/ha, they will be just as profitable as canola in the year of production (based on long-term average prices).

Figure 12.4: Former RRA team member Alice Butler and grower Glenn Ball at the break crop trial in 2018.

Burrell – Faba beans spread risk across soil types in West River

Emma Pearse, DPIRD Esperance

SNAPSHOT

Growers: Lloyd Burrell
Location: West River
Enterprises: Wheat, barley, faba beans, and canola
Growing season rainfall: (2020: 206mm)
Years growing beans: 3
Typical rotation: Canola, wheat, barley, beans

Paddock set-up 2020

Soil type	Very variable soil type, sandy loam to heavy clay pH($CaCl_2$) 5.3 - 6.9
Variety	PBA Samira
Seeding rate	100 kg/ha
Row spacing	25.4 cm (10 inch)
Seeding date	Dry sown on 16 April (opening rains 19 April)
Seeding set-up	Skip row every third row and then rolled behind seeder
Inoculant	Double rate of peat
Nutrition at seeding	10 kg/ha P and Zn at seeding
Broadleaf herbicide strategy	Flumioxazin (Terrain®) IBS
In-season nutrition	None

2020 in-season management

	Target	Input
Fungicides	Cercospora	Tebuconazole
Insecticides	Budworm	Gamma-cyhalothrin (Trojan®)
Desiccation/Crop-topping	Various weeds, mainly grasses	Paraquat (e.g. Gramoxone®)

Faba beans as a double break across variable soil types

Lloyd's property has variable soil types that can change many times within the one paddock — from sand, to ironstone gravel, to loamy duplex soils. He has been growing faba beans for three years as a break crop and has found that they have grown well across most of his soil types. Traditionally, Lloyd has grown field peas but has included lupins, lentils, and faba beans in his program to spread production risk, under variable seasonal conditions and soil types. He has had issues with lentils, which have not performed well over the last few dry years, and which are only suited to a narrow range of soil types. Growing the four different legume species has also allowed Lloyd to spread his frost risk. Lloyd uses a double break in the rotation to get control of grass weeds. By using the legume break followed by canola he has found he has much cleaner paddocks to then sow wheat and barley. Overall, while still including the different legume varieties, he has found that the faba beans are currently the best fit as a break crop because he can grow them anywhere across the whole farm.

Figure 12.5: Lloyd can achieve good establishment of faba beans across most of his soil types.

Photo taken where the soil type is clay loam.

Disease mitigation

Lloyd keeps his seeder bar set-up on 10-inch (about 25cm) row spacing when sowing his beans; however, he blocks off every third tine to get wider rows. This set-up increases airflow through the faba bean canopy to reduce disease risk (Figure 12.5). This set-up also increases the amount of light penetration to the lower canopy of the plant.

Faba beans are better to market

Although Lloyd has had success with lupins, prices in the past have been too low and markets are not appealing. In his experience, faba bean markets can be more reliable as prices are generally high and more market opportunities exist. Although it is possible to sell food-grade faba beans, Lloyd has been selling his faba beans to local sheep producers as stock feed with good returns. Faba beans are not yet widely acknowledged as stock feed and Lloyd believes this can be improved upon to increase demand and will be important as faba beans become more widely grown in WA.

Figure 12.6: Every third seeding tine is blocked off to create a skip row and increase row spacing.

Harvesting faba beans

Easier harvesting has been a major drawcard for Lloyd for growing faba beans. Field peas can be very difficult to pick up during harvest as they fall over as they mature and therefore the header front needs to be very low to the ground. Faba beans remain upright and so the header front can be set higher. There can still be issues in poor seasons when pods are set low to the ground. Lloyd has observed that a lot of seed can be left on the ground if harvesting is not done properly.

Other challenges

During the wheat phase of the rotation, Lloyd has previously used clopyralid (e.g. Lontrel®) with his broadleaf weed spray to control summer germinating fleabane. Chemical residues from this application damaged his faba beans, causing stunting and discolouration in subsequent seasons, particularly in sandier areas. The damage was visible early in the season and led to less pod-set in the affected areas. This challenge has led Lloyd to try to phase out clopyralid from his system.

Foulds – Soil nitrogen for improved cereal yield and quality prove faba beans as a legume of choice in Hopetoun

Emma Pearse, DPIRD Esperance

SNAPSHOT

Growers: Courtney Foulds
Location: Hopetoun
Enterprises: Wheat, canola, barley, and faba beans
Growing season rainfall: 250mm
Years growing beans: 5
Typical rotation: wheat (or barley), canola, faba beans

Paddock set-up 2020

Soil type	Loam to heavy clay, pH 4.5–5.5
Variety	PBA Samira
Seeding rate	130 kg/ha
Row spacing	25 cm
Seeding date	Dry sown on 8 April (opening rains 19 April)
Seeding set-up	Disc seeder
Inoculant	Peat
Nutrition at seeding	60 kg Agstar Xtra (CSBP)
Broadleaf herbicide strategy	N/A
In-season nutrition	Mn and Zn with every drive over the paddock

2020 in-season management

	Target	Input
Fungicides	Chocolate spot	Carbendazim twice in the season
Desiccation/Crop-topping	Grass weeds	Glyphosate and paraquat

Alternative legume in the system to boost cereal yields

Courtney previously grew field peas as his legume break crop in his cropping rotation. After years of difficult harvests, he decided to grow canola as his only break crop. After three years of a rotation of wheat, barley, and canola, Courtney realised he needed a legume back in the system to boost soil nutrition. He has now been growing faba beans for five years and his typical rotation is wheat, canola, faba beans; or barley, canola, faba beans. For Courtney, the best reward for growing a faba bean crop comes from the increase in cereal yields in the following year — in his 2020 harvest, he saw about a 400kg/ha increase in wheat grown on faba bean stubble compared to wheat grown on canola stubble.

No change to nutritional package post-faba beans and continued response two years after growing

Courtney does not reduce the amount of N he applies to cereals following a faba bean crop compared to following canola. Previously he did reduce N inputs to his wheat after a faba bean crop; however, he finds that by not reducing N inputs he can get more out of the nutritional boost the faba beans provide. He finds that this increases his yields and his protein. Anecdotally, he has found that there is a sustained benefit two years after growing faba beans, with better early vigour of canola when grown on faba bean stubble compared to cereal stubble.

Harvesting an easier operation with faba beans

Faba bean crops are easier for Courtney to harvest, particularly when pod-set is higher up the canopy. He uses a tin front on his header, which he finds picks up the pods better than a draper front. In previous years where pods have set lower, harvest has been more difficult and more losses have occurred out the front of the header. If pods continue to set high on the plant, this will boost overall yield and make harvest simpler.

Soil type is important and ameliorate where needed

Courtney can grow faba bean crops across most of his farm but he has found that they struggle more on his heavy clay country where pH is lower (4.5–5.2), compared to the loamy areas where the pH is slightly higher (>5.5). Liming with cultivation to incorporate occurs every three years but he may increase the rates to further increase the pH in these areas.

Going further with faba beans

Faba beans have proven to be successful in Courtney's rotation so far but he is eager to try more things, such as moving into skip rows with his seeder set-up to alter the plant architecture, which could help with harvestability and disease prevention.

Courtney is keen to see more information and research into how to achieve better grades. This would mean better understanding of the cause of faba bean discolouration.

Courtney currently grows both PBA Samira and PBA Bendoc, but he is keen to move towards all PBA Bendoc to be able to use IMI herbicides in his system. If he can maintain or increase his faba bean yields, Courtney will aim to increase the number of hectares allocated to them.

Goad – Faba beans succeed on the south coast sandplain after soil amelioration

Carla Milazzo, DPIRD Albany

SNAPSHOT

Growers: Tony, Mel, Josh, and Shannon Goad
Location: Kojaneerup
Enterprises: Barley, canola, faba beans
Growing season rainfall: 200–350mm (2020: 230mm)
Years growing beans: 4
Typical rotation: Barley/wheat, faba beans, canola

Paddock set-up 2020

Soil type (pH, texture)	Pale deep sand, deep sandy duplex (sand over gravel, sand over clay) pH($CaCl_2$): Topsoil <5 before liming; >5.5 after liming (4t/ha lime). Subsoil 5–5.5.
Variety	PBA Samira
Seeding rate	200 kg/ha
Row spacing	25 cm
Seeding date	Dry sown on April 28 (opening rains May 6)
Seeding set-up	Adjusted the seeder to single chute boots with a wider air hose diameter of 3.2 cm (1.25 inches). Dry seeding 8–10 cm deep.
Inoculant	Previously used ALOSCA® granules (10 kg/ha) but this year used both ALOSCA® and peat.
Nutrition at seeding	120 kg/ha K-Till
Broadleaf herbicide strategy	Pre-emergent used Terbuthylazine (e.g. Terbyne®) and trialled some flumioxazin (Terrain®); next year will try fomesafen (Reflex®). Post-emergent used pyraflufen-ethyl (e.g. Ecopar®) at the 4–6 leaf stage, and had minimal crop damage; however, still dealing with late-germinating canola and radish. Crop-topping to clean up canola and radish, hopefully before shedding, and planting RR canola following faba beans.
In-season nutrition	None

2020 in-season management

	Target	Input
Fungicides	Chocolate spot, cercospora	Veritas® (tebuconazole + azoxystrobin), probably not required
Insecticides	Budworm	Trojan® (gamma-cyhalothrin) in same pass as fungicide
Desiccation	Harvest aid	Paraquat and saflufenacil (Sharpen®)

Strategic soil amelioration

Josh Goad says getting the pH right in the root zone is the top amelioration goal for growing faba beans. The Goads prepare paddocks for faba beans by spreading 2t/ha lime, then deep ripping with inclusion plates to incorporate the lime, before spreading another 2t/ha lime on top. They also clay very light areas at 250t/ha, which is a one-off investment with long-term benefits, at $600/ha upfront. In the past few years, the clayed area has struggled to establish due to the dry starts to the growing season, although it has caught up in yield overall.

With this program, the soil pH($CaCl_2$) has increased to levels suitable for faba bean production. Before liming, topsoil pH was about 4.8. After liming this increased to 5.6–6.2, and to 5.2–6 down to 30cm.

iLime

The iLime app, developed by DPIRD and GRDC, estimates the rate of soil acidification, the lime requirements for the paddock to recover from soil acidification (to a target pH($CaCl_2$) of 5.5 in topsoil and 4.8 in subsoil), and how often to lime for maintaining pH.

Under Josh's liming strategy and with the farm's soil type, rainfall, rotation, and yields as customised inputs, the app estimates the topsoil will remain just under pH 5.5 until year 10 when pH will start to decline steadily.

Figure 12.7: Surface spread lime is incorporated by deep ripping with inclusion plates.

Finding the right inoculant for sandy soil

In 2020 the Goads dry seeded 70ha with PBA Samira that was inoculated with ALOSCA® as well as peat. In the past they have experimented with peat but found it inefficient and not particularly effective, so opted for the simpler option of granules only in 2019, which better fits their dry seeding operation. They are still experimenting with inoculation to achieve the best outcome, going to a combination of peat and ALOSCA® granules in 2020, though in 2021 they might try TagTeam® inoculant, which is a peat granule. Nodulation was sufficient with lateral nodules more common than crown nodules. Rhizobia survival significantly reduces in dry conditions and this was observed in the nodulation scores. Despite the dry start, the faba beans emerged two weeks after sowing and established very well at around 50plants/m^2. In previous seasons, Josh sowed at 160kg/ha; in 2020, he wanted to increase plant density and so used a higher seeding rate (200kg/ha).

Broadleaf weed control – trialling chemical options

The Goads have identified broadleaf weed control, particularly wild radish, as a major challenge. In the 2020 season, Josh used terbuthylazine (e.g. Terbyne®) pre-emergent and trialled 13ha flumioxazin (Terrain®); however, he did not notice any practical difference in weed control. Josh notes that there are not many in-season broadleaf control options for faba beans, though this is improving. The Goads tried imazamox (Raptor®) in past years and Ecopar® recently, and hope crop-topping reduces seed-set. The registration of fomesafen (Reflex®) in March 2021 will increase residual pre-emergent broadleaf control and Josh is looking forward to trialling it. As a way of keeping the weed burden under control, the Goads are sowing Roundup Ready (RR) canola after faba beans to clean up wild radish in the paddock.

Marketing faba beans

On average, the Goads' faba bean crop yielded 2t/ha across the paddock in 2018, 2.4t/ha in 2019, and 1.7t/ha in 2020. Harvest losses have been considerable, estimated at up to 350kg/ha left behind both in pods that were too low to pick up as well as losses out the back of the header. Although the Goads have some on-farm storage capacity, maintaining cash flow is a high priority so they would rather sell grain close to harvest. Due to the lack of a container market at Albany, the faba beans are trucked and exported from Fremantle. In recent years they have capitalised on price volatility with favourable faba bean prices. Although faba bean prices have declined since the Goads started growing them, Josh says even last year when they got $530/t (2019/2020 harvest), faba beans were still their most profitable crop.

Grass Patch – Increased herbicide options, soil nutrition, and reduced frost-risk are the drivers for adding faba beans to the system

King Yin Lui, DPIRD Esperance

SNAPSHOT

Location: Grass Patch
Enterprises: Wheat, barley, field peas/faba bean
Growing season rainfall: 2020: 145mm
Years growing beans: 4
Typical rotation: Wheat, barley, peas/faba beans

Paddock set-up 2020

Soil type	Crops on both heavy clay soils and sandy duplex soils
Variety	PBA Samira
Seeding rate	100 kg/ha equivalent to 18 (good zone) and 14 (bad zone) plants per m2
Row spacing	25.4 cm (10 inch)
Seeding set-up	Rolls heavier country only, not on sandy duplex soils
Inoculant	Peat. Tried ALOSCA® previously but too expensive and did not notice any benefits
Broadleaf herbicide strategy	Diuron and trifluralin IBS on lighter soil types that are not rolled; imazethapyr (e.g. Spinnaker®) on heavier soil types that are rolled after seeding

Faba beans a lower risk break crop than canola

For this grower in Grass Patch, the benefit provided by pulses outweighs the risk of cropping canola. They now operate on a 6-year rotation of field peas, wheat, barley, faba beans, wheat, barley. The long-term sustainability of the farm is important to the family; therefore the contribution to soil health and nutrition, as well as the disease and nematode break, offered by faba beans is more appealing compared to canola. As their average canola yields were similar to faba beans, they could not justify the risks of establishing canola in dry conditions on heavy soils in the medium- to low-rainfall zone of the Esperance Mallee.

Faba beans have been grown on the farm since 2016. They have been satisfied with the range of yields achieved, despite experiencing three poor seasons out of four. They sow wheat after a pulse, usually applying 30kg/ha of N with 12–15kg/ha of P, aiming to produce an average 2.5t/ha wheat crop. In a good season they can get up to 4t/ha of wheat, compared with 1.5t/ha in a dry season. If they sow barley after wheat, they apply approximately 50kg/ha of N. They estimate they achieve a 1.5t/ha wheat crop after canola, but expect a 2.5t/ha wheat crop after faba beans with the same amount of upfront N applied (30kg/ha N). They have observed that the N benefits to wheat after a pulse crop come from the addition of fixed N in addition to how and when it is made available to the following crop. In the past two dry seasons, cereals following a pulse have finished better overall compared to when synthetic N is applied.

When asked whether they would consider cropping canola again, they said only if they needed an option for a double break to clean up resistant ryegrass. They are currently using long chemical fallows to manage weeds in problem paddocks. Although the chemicals might cost about $60/ha, the long-term benefit for weed control and water conservation pays for itself, especially if they can grow a pulse after the fallow to further control grasses and then give a boost to the following cereal. In addition, they would like to trial vetch in place of a chemical fallow — sowing vetch early and desiccating it before it set pods to clean up any weeds and to add N to the system.

Reduced frost risk from growing faba beans compared to field peas

The inclusion of faba beans into the program spreads frost risk from the other break crop grown, field pea, which is more susceptible to frost. They are hesitant to try other pulses like lentils and chickpeas because their current harvest set-up is not optimised for those crops and height of those crops make them look 'harder to harvest than a poor pea crop'.

Figure 12.8: Faba bean sample from 2020 harvest of grade 1 (right) and grade 2 (left) faba bean downgraded due to discolouration from frost.

More weed control options in faba bean crop and in the rotation

Like many pulse growers, this grower identified broadleaf weed control as the biggest challenge to growing faba beans. The main weeds present are wild turnip and capeweed, especially when they emerge in the furrow. On heavier soils, imazethapyr (e.g. Spinnaker®) is applied PSPE after rolling. They get better control with this strategy on heavy clay soils than on sandy duplex soils, where they do not roll after sowing due to increased wind erosion risk. On sandy duplex soils diuron is applied IBS. The timing of application of pre-harvest herbicide as a desiccant and crop-topping manages ryegrass before seed-set.

New faba bean varieties with imidazolinone (IMI) tolerance, such as PBA Bendoc, are an attractive option to broaden herbicide options in the rotation, particularly to grow faba beans after IMI chemicals are applied in-crop on IMI-tolerant barley.

Problems with growing faba beans so far

In 2020 a strong wind event during podding led to 'necking' of a large area of faba beans on lighter soil types. These had established well, with good early vigour and increased biomass early in the season before the conditions became drier. Necking could pose a problem at harvest as pods would be harder to pick up. In general, harvesting faba beans has not been a problem. On rolled paddocks the use of lifters in low biomass crops helps reduce losses where pods have been set too low. They have noticed more losses off the header front when harvesting during hot conditions compared to during the cool of the night.

No major changes or new machinery investments were needed to start growing faba beans. The grower did experience some splitting of seed initially when blockages occurred in the auger that transferred seed to the air cart. Now they use a large auger when transferring seed but would ideally like to use a conveyor belt system to avoid seed damage.

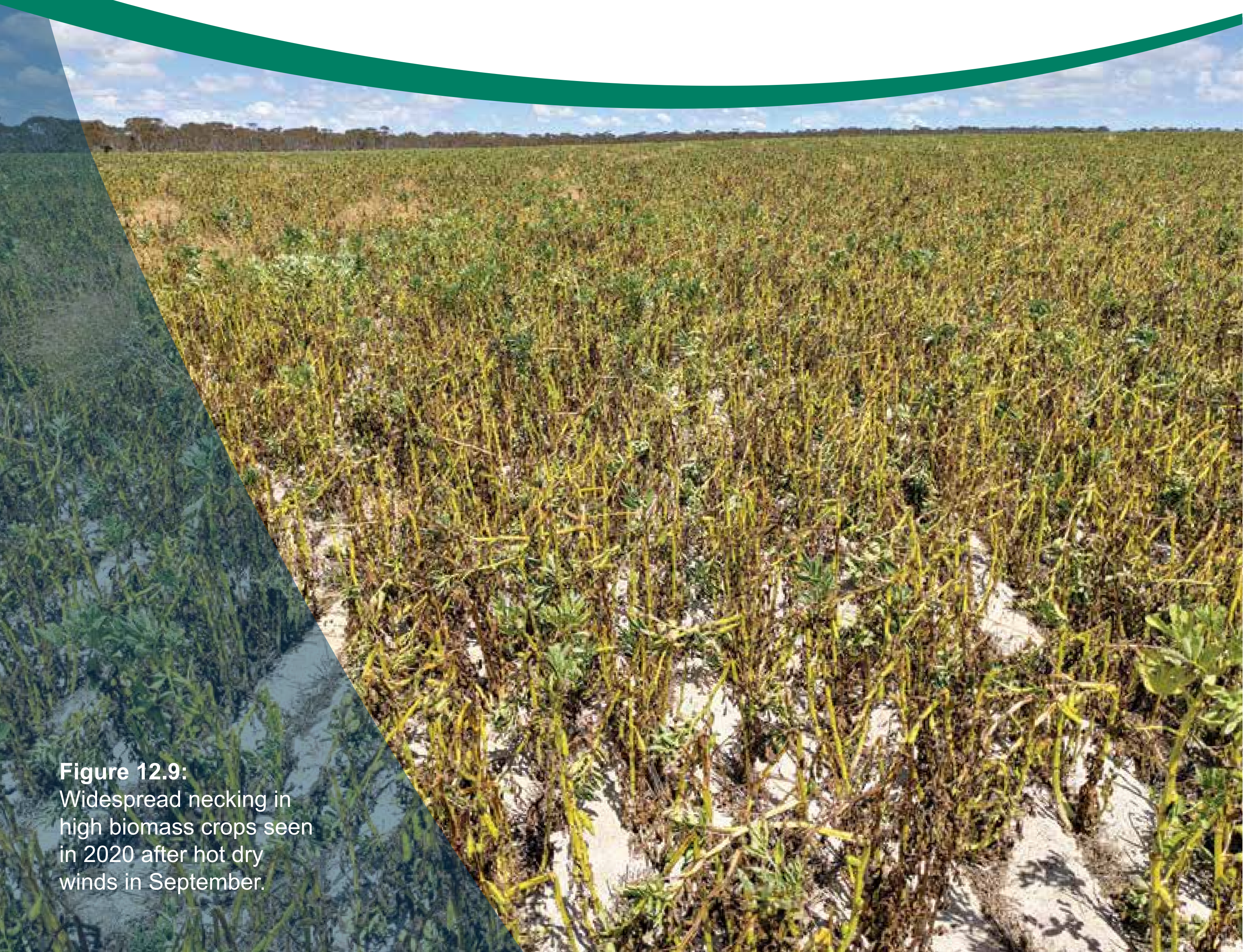


Figure 12.9: Widespread necking in high biomass crops seen in 2020 after hot dry winds in September.

Harding – Benefits of wide rows at Ongerup

Carla Milazzo, DPIRD Albany

SNAPSHOT

Growers: Wes Harding
Location: Ongerup
Enterprises: 100% cropping
Growing season rainfall: 250mm (2020: 220mm)
Years growing beans: 7
Typical rotation: Wheat, barley, canola, wheat barley, faba beans

Paddock set-up 2020

Soil type (pH, texture)	Dark grey sand over clay. Top soil pH($CaCl_2$) on average 5; subsoil more alkaline 5.5–6.
Variety	PBA Samira
Seeding rate	140 kg/ha
Row spacing	75 cm
Seeding date	Dry sown mid-April to May (opening rains 30 May)
Seeding set-up	Separate 12 m DBS bar for beans, with a dual chute system for seed and fertiliser separation (all dry/granular).
Inoculant	Nodulator® granules (BASF)
Nutrition at seeding	50–60 kg/ha MAP
Broadleaf herbicide strategy	Summer spraying using Weed-It (precision green-on-brown). Paraquat knockdown. Pre-emergent propyzamide and terbuthylazine (Terbyne®) and trialling flumioxazin (Terrain). Post-emergent capacity for shielded spraying but have not been needing it due to low weed burden. No post-emergent broadleaf spray was used in 2020.
In-season nutrition	None

2020 in-season management

	Target	Input
Fungicides	Chocolate spot	Carbendazim
Insecticides	Budworm	Not required
Desiccation/Crop-topping	Wild radish, milk thistle	Glyphosate and saflufenacil (Sharpen®)

The Hardings understand the importance of having a robust, profitable legume in their 100% cropping enterprise near Ongerup. They aim to alternate canola and faba beans as a break crop between a two-year cereal phase, and in 2020 they seeded 750ha of faba beans, including a paddock that grew their first faba bean crop seven years ago. Over time, Wes has adopted wide rows, deep sowing, and granular inoculation and continues to refine his faba bean production system.

Inoculating and dry seeding

In 2020, some of the faba bean country was deep ripped before sowing — this area was sown first, 10cm deep, where there was more moisture. The unripped paddocks were dry sown slightly shallower at 6–10cm. The Hardings have experimented with different forms of inoculant over the years but for the past two seasons have used Nodulator® granules. These fit their dry seeding system well, being easier to handle and more flexible than peat in terms of the sowing window. Compared to ALOSCA® granules, Wes has found Nodulator® to be a more effective formulation with less dust and therefore more inoculant getting into the furrow. Wes is very happy with the nodulation they achieve with this system.

Row spacing to optimise establishment and manage crop canopy

The Hardings began growing beans on regular 30cm spacings for the first two years but decided to move to wide rows for shielded spraying opportunities and better canopy management. Originally, they tried standard skip row spacings (60cm) but then Wes adapted a second-hand 12m DBS bar for sowing faba beans on 75cm rows, based on Mark Wandel's system. At this spacing they get better plant establishment with a greater proportion of on-row or near-row sowing (without a ProTrakker®). On-row or near-row sowing provides a substantial moisture capture advantage in dry starts. They intended to use shielded spraying with this system but have not yet faced the need or conditions to use the shielded sprayer (no heavy weed burdens, or conditions too dry). Wes observes that in dry years like the past few seasons, 60cm rows might have been better but in wet years 75cm rows allow for superior canopy management by significantly reducing leaf wetness and humidity and therefore reducing disease pressure. Row spacing also influences canopy architecture. Wes has noticed that on headlands where the crop gets double sown the plants are about 30cm taller but are less bushy and have fewer pods. Wide rows encourage the plants to branch and grow bushy as they compete less with other plants.

Nutrition on wide rows

Wes bases his nutrition decisions at seeding on the P requirement of the crop. Typically, 50–60kg/ha MAP goes down the tube, which delivers 12–13kg/ha of P. Fertiliser concentrations near the seed must be considered on wide rows as there are fewer seeds per unit area. Although some separation exists between seed and fertiliser with the dual chute system, deep sowing can make seed separation harder. For a while, the Hardings were putting K down the tube as well but Wes suspects they were burning the seedlings a bit, especially in dry starts.

Monitoring for weeds, pests, and disease reduces inputs

Despite being set up for shielded spraying, the Hardings have achieved good broadleaf weed control from a knockdown (paraquat) and good residual pre-emergent herbicides (propyzamide and terbuthylazine (Terbyne®) IBS). They also trialled flumioxazin (Terrain®) in 2020. In 2020 the faba beans did not require a post-emergent broadleaf spray; however, some hand weeding was needed late in the season. Wes is careful not to touch-up the faba beans, if possible, as this can increase their susceptibility to disease. Wes desiccates with either paraquat or a mixture of glyphosate and saflufenacil to control any wild radish that has been missed.

Wes inspects the crop regularly to check for pest incursions. In 2020, he observed low levels of budworm mid-season but the population did not increase and therefore they did not spray for this pest. Similarly, he observed low levels of chocolate spot at late flowering, which was sprayed with carbendazim to prevent it from spreading. In more disease-conducive (e.g. wetter, higher humidity) seasons he might spray earlier in the season to prevent early disease establishment.

Figure 12.10: Carla Milazzo and Wes Harding inspecting the crop at flowering. Wide rows at 75cm row spacing aid in canopy management.

Mansell – Faba beans expand possibilities to include pulses into the rotation in Beaumont

King Yin Lui, DPIRD Esperance

SNAPSHOT

Growers: Steve and Ruth Mansell
Location: Beaumont
Enterprises: Barley, canola, lupin, faba bean, wheat
Growing season rainfall 2020: 310mm
Years growing beans: 1

Paddock set-up 2020

Soil type	Sandy loam to clay loam
Variety	PBA Samira
Seeding rate	100 kg/ha
Row spacing	30.5 cm (12 inch)
Seeding date	Dry sown on 8 April (opening rains 19 April)
Seeding set-up	Rolled
Inoculant	Hi-Tech Ag Green Rhiz peat inoculant
Broadleaf herbicide strategy	Terbuthylazine (e.g. Terbyne®) PSPE

2020 in-season management

	Target	Input
Fungicides	leaf disease; chocolate spot	2x tebuconazole** with grass selective 1x Aviator Xpro® (prothioconazole + bixafen) at flowering
Insecticides	Cowpea aphid	insecticide
Desiccation/Crop-topping	Pre-harvest	diquat (e.g. Reglone®)

*** Tebuconazole not registered for control of chocolate spot*

After seeing faba beans trialled for two years on his brother's farm next door, Steve Mansell tried them on a paddock that has not had a grain pulse on it since 1978, which was when the land was cleared. The pH of this paddock was considered too high and the soil type too heavy to be suitable for growing lupins, although they regularly crop lupins on lighter country on the farm. The paddock had been on a continuous canola–wheat rotation for some time. In addition to the heavy soil type, the paddock is very undulating, with lots of kopi (calcareous) hollows that get waterlogged — this makes field peas too risky to crop and difficult to harvest.

Steve is pleased with how his faba beans performed in 2020 and would like to continue trialling them, although a price drop has made him think twice about jumping in again immediately; he will consider prices coming into 2021 to decide whether to sow them again. If he did, he would try them on a similar soil type in a place where he currently sows lupins to see how they compare.

Above average yields in 2020 despite some waterlogging

Heavy rainfall in August caused some areas of waterlogging. Some of the faba beans were badly affected on a paddock that is prone to heavy waterlogging but, overall, the lupins seemed to fare worse. By the end of season, the faba beans yielded about 2.5t/ha and the lupins 1.8t/ha. Overall, cereals performed about 300–600kg/ha above the long-term average and canola was 100kg/ha more.

Steve has seen faba beans trialled on the sandier soils of the farm next door where lupins are usually grown and they have established and performed well. He said that he would think about trying skip rows after seeing that successfully done in the Esperance port zone. Steve is currently on 30.5cm (12-inch) row spacing. The Mansell's farm received some summer rain in January 2020, which helped the crop put on biomass early. Although seasonal conditions were not conducive to disease, they applied tebuconazole with the grass-selective herbicides and later applied Aviator Xpro® as a preventive measure at mid-flowering, in late August.

Figure 12.11:
Faba beans trialled in the 2020 season in a paddock with kopi hollows in a clay loam area of paddock that regularly gets waterlogged and where is it is difficult to harvest short crops.

Photos taken in June and September 2020.

Figure 12.12: Soil cores from (left) higher-yielding area of the paddock and (right) lower-yielding area of the paddock (as photographed in Figure 12.11)

Photo courtesy of Aiden Sinnott, VRT Solutions.

Cowpea aphid proliferates in stressed crop

The drought-stressed faba bean crop allowed cowpea aphid colonies to spread throughout the whole paddock in 2020. The Mansells used untreated seed and the experience from Steve's brother, John, was that these aphids are often present but usually do not pose a problem in faba beans. The crop established well after being sown in late April but, with dry winter conditions, the stressed crop created a host that was ideal for the cowpea aphid to proliferate and spread across the paddock. Steve said that he delayed spraying as long as possible, waiting for some rain to help the crop tolerate the infestation, but ended up spraying with insecticide.

Chipped grain from over-threshing downgrades faba beans

Faba beans are prone to getting chipped and split from mechanical handling. Steve had to learn this lesson the hard way when a large proportion of the harvest was defective because of over-threshing the crop. The Mansells run 10.90 New Holland headers and draper fronts. Taking out every second wire from the concave, using a low speed on the roller and having the concave extension set to the biggest setting seemed to overcome this problem and the rest of the grain should come close to farmer-dressed grade 1. The deciding factor now is seed-coat colour. Much of the crop had necking which made it difficult to pick up. They run a draper front and had the finger reel extended out to avoid the crop falling flat on the ground.

Marold – Faba beans in a high-rainfall area prone to disease and waterlogging

Emma Pearse, DPIRD Esperance

SNAPSHOT

Growers: Rohan and Ruth Marold
Location: Dalyup
Enterprises: Wheat, barley, canola, and faba beans
Growing season rainfall: 2020: 388mm
Years growing beans: 4
Typical rotation: Wheat, beans, wheat canola

Paddock set-up 2020

Soil type	~5 pH, heavier soil texture avoids deep sands
Variety	PBA Samira
Seeding rate	80–90 kg/ha (10 cm depth)
Row spacing	25.4 cm (10 inch)
Seeding date	Dry sown on 5–10 April (opening rains 6 May)
Seeding set-up	Seeder set-up does not change from the rest of the program. Not rolled in general; only rolls where there are rocky outcrops
Inoculant	ALOSCA® granules – dry seeding
Nutrition at seeding	DAP 50 kg/ha
Broadleaf herbicide strategy	Terbuthylazine (e.g. Terbyne®) IBS. No post-emergent broadleaf spray.
In-season nutrition	Cu, Zn, Mn

2020 in-season management

	Target	Input
Fungicides	Cercospora; Chocolate spot	Tebuconazole; carbendazim, and tebuconazole + azoxystrobin (Veritas®)
Insecticides	Cowpea aphid	insecticide
Desiccation	Harvest aid	Paraquat and saflufenacil (Sharpen®)

Faba beans represented a lower risk break crop option than canola

The Marolds' farm is in the high-rainfall area and very susceptible to waterlogging. They have clayed and deep ripped their sands to ameliorate non-wetting and waterlogging. Despite this, canola is too risky to grow as the primary break crop on the waterlogged areas. The Marolds have previously grown lupins; however, they found that lupins do not grow well in waterlogged conditions and yield less than faba beans. With faba bean prices being consistently higher and markets more reliable, it was an easy decision for the Marolds to switch.

Disease the main challenge

Rohan Marold is worried about chocolate spot in the faba beans and considers this one of the main challenges. In the first year of growing faba beans (2016), conditions were very conducive to disease and the crop was wiped out by chocolate spot. They have not had disease as severe since that year. Currently the Marolds grow PBA Samira; however, they are very interested in growing PBA Amberley for its improved disease resistance. They have acquired some PBA Amberley seed to try for the 2021 season to compare differences between the two varieties. To combat chocolate spot, Rohan sticks to a good fungicide regime and sows at a slightly lower seeding rate than recommended. Chocolate spot became evident much later (mid-August) in the 2020 season than was usual for the Marolds and they found a combination of applying carbendazim at the start of August and tebuconazole + azoxystrobin (Veritas®) at the end of August controlled it well. Rohan is interested in more research into controlling disease, including how seeding density and wider row spacing have an impact.

Sheep for weed control?

Wild radish and capeweed are another challenge that the Marolds face when growing faba beans. Currently Rohan is tackling this with terbuthylazine (e.g. Terbyne®) applied IBS along with grazing the crop early with sheep. Rohan puts sheep into the paddock once the faba beans have established some substantial growth (Figure 12.13) and removes them before the plants are too large and could be damaged by trampling. He will only put sheep in faba bean paddocks that have an area of pasture for the sheep to graze. The sheep prefer to eat the weeds and not the faba beans. Rohan does not apply a post-emergent broadleaf herbicide in season as there are no options that he is satisfied with. Planting PBA Bendoc could be an option with the IMI-tolerant trait but Rohan is reluctant to start using the Group B chemicals in his system. Grass weeds are targeted in-season with clethodim and butroxydim (e.g. Factor®) applied early followed by another application of clethodim later in the season. This allows the Marolds to get good control on both early- and later-germinating seed. They find desiccating with paraquat and saflufenacil (Sharpen®) cleans up the remaining ryegrass, along with the wild radish and capeweed.

Figure 12.13:
Faba bean paddock showing growth stage for grazing sheep.

Marshall – Tactical break crop option for root disease, water logging, and grass management in long-term cereal–canola rotation

King Yin Lui, DPIRD Esperance

SNAPSHOT

Growers: Dave and Steve Marshall and families
Location: Cascade, Dalyup
2020 growing season rainfall: 195mm
Years growing beans: 2
Typical rotation: Canola/pulse, wheat, wheat/barley

Paddock set-up 2020

Soil type	Sandplain (Dalyup) and sandy loams (Cascade). pH($CaCl_2$) 6-7
Variety	PBA Samira, Gaucho treated
Seeding rate	100 kg/ha, 12 plants/m^2
Row spacing	30 cm
Seeding date	Dry sown on 30 April (opening rains 17 June)
Seeding set-up	Discs
Inoculant	ALOSCA® granules
Broadleaf herbicide strategy	Flumioxazin (Terrain®) PSPE
In-season nutrition	350 g Verno Cu, Zn 750 g Mn with grass spray.

2020 in-season management

	Target	Input
Fungicides	Chocolate spot	Tebuconazole/azoxystrobin (Veritas®)
Insecticides	Budworm	Gamma-cyhalothrin (Trojan®)

Faba beans offer a tactical break to root lesion nematodes (Pratylenchus neglectus)

The Marshalls' typical rotation is canola, wheat, wheat/barley, block sowing to cereals or break crops to match the rotation. Stubble retention, controlled traffic farming, minimal soil disturbance at seeding and years of liming to fix soil pH to depth have significantly improved yields across all crop-types over the past 12 years. These factors have meant that some root diseases have started to become a problem, particularly RLN levels which have increased in some areas. In 2020, faba beans were sown on a paddock that would typically have been sown to wheat in their block sowing system. The paddock had significant yield loss from RLN in previous years and so had a high risk again in 2020. Despite the logistical challenge of managing a broadleaf crop there, they planted faba beans to suppress nematode numbers (faba beans are poor hosts for the nematodes compared to wheat and canola) and reduce the risk to future crops.

Greater herbicide options and grass control benefits

The Marshalls did not sow faba beans in the same block as the other break crop (canola) in 2020 because they used clopyralid (e.g. Lontrel®) on the wheat grown in 2019 and so there was a high risk of crop damage from herbicide residue. They will avoid using clopyralid in the future and aim to sow one-third of the break crop area to faba beans and two-thirds to canola.

They see extra value in faba beans due to additional ryegrass control options. During the season, they use clethodim and high rates of butroxydim (e.g. Factor®) and then crop-top with paraquat to control resistant ryegrass populations. There is not enough benefit from adopting RR canola varieties to help manage weeds. They currently sow HyTTec® Trident and InVigor® T 4510 triazine tolerant (TT) canola varieties.

Broadleaf weeds remain a problem, primarily volunteer canola in early-sown crops, and they currently apply flumioxazin (Terrain®) PSPE.

Correcting soil pH key to success, allowing faba beans to be sown on the sandplain

The Marshalls started liming 12 years ago in response to problems with acidity and Al toxicity. They have spent a lot of time and money liming which has drastically improved yield and has allowed them to confidently crop faba beans. Their liming strategy has been to apply 2–2.5t/ha of lime yearly over the past 12 years, achieving a pH of 5.5 to depth and pH 6–7 on the surface (0-10cm) across the farm, relying on rainfall and seeding operations to incorporate the lime. Liming has seen average wheat yields go from 1.7t/ha eight to ten years ago to nearly 5t/ha in recent years. Since they started liming, 2020 is the first year they have not applied lime. In total, they estimate 12t/ha of lime, obtained from the local lime pit, has been applied on their coastal sands in Dalyup and 8t/ha of lime at Cascade.

They understand the importance of keeping a pulse crop in the system as they push the potential of the farm. Fixing soil pH now results in positive responses to ripping and better efficacy of herbicides and other crop protection inputs. They did a ripping trial in summer 2018–2019, where there was compaction layer at 30cm that was subsequently sown to canola in the 2019 season. No significant yield response in canola occurred but they saw some amazing differences in biomass in wheat (cv. Scepter) sown in 2020 and are hoping to see big differences in yield. Improvements in soil pH has resulted in better root penetration from liming and ripping and better response to herbicides.

They see the potential that faba beans bring — a profitable option in the year sown and having positive benefits in the farming system overall. Although they have not tried altering the N rate in cereals following faba beans, they have noticed a visual difference after faba beans compared to canola side-by-side, where wheat following faba beans seem to have more tillers and biomass. They are yet to get a feel for the yield and protein response after faba beans.

In 2020, they sowed faba beans on the sandy loam soils of their northern farm in Cascade, where they received 185mm rainfall during the growing season (April–October), compared to 300mm on their coastal sandplain farm in Dalyup. Faba beans averaged 0.8t/ha off the header, which was a disappointing result (wheat on wheat stubble yielded just under 3t/ha on the same block), wheat after canola was approximately 3.5t/ha on a block that received 25mm less rainfall in the growing season. Despite the disappointing season, they still see the potential that faba beans bring in being a tactical break crop option that have positive benefits to the farming system that isn't offered by sowing canola. They remain positive about faba beans and will continue to trial them to try to get a system that will work for their business.

Management option for waterlogging, but hesitant to crop bigger area as canola far outperforms faba beans in dry years

Waterlogging is a major constraint on their coastal block even though the 2019 and 2020 seasons of sowing faba beans have been relatively dry and waterlogging has affected the farm less than usual. In 2019, canola on their coastal sandplain block in Dalyup performed above average in the absence of waterlogging and overall, during drier years, canola outperforms faba beans. Their experience is that canola is not very tolerant to waterlogging and they hope that faba beans might help spread the risk, especially in hollows where they manage water using raised beds.

How do faba beans stack up against other pulse options of lupins, field peas, and vetch?

Faba beans are the best fit into their system in terms of machinery and controlled traffic set-up, which is a priority for them on sandplain soils prone to wind erosion. For example, issues associated with harvesting peas, potentially on an angle, do not fit into the controlled traffic set-up. Additionally, they can direct harvest faba beans using existing draper fronts set-up for cereals. They have soils that are suitable for lupins but these generally do not pay enough; the Marshalls think they get as much or better rotational benefits from faba beans. However, selling faba beans can be challenging. They would consider storing faba beans in bags for a short time after harvest to sell to the local marketer if the price is right. Prices dropped (from $700 to $550) after the 2019 harvest which meant that growing faba beans was not economically viable for the long term. Luckily, the Marshalls found a local livestock producer who purchased them for protein feed and so they were able to sell them locally for a reasonable price.

They previously trialled vetch (cv. Capello) as a brown manure. The vetch had some benefit to the following crops in rotation through added yield and protein but the Marshalls want something that pays for itself in the year sown, referring to the vetch as a 'nothing year'.

Where to next?

The Marshalls will trial the variety PBA Amberley. Its better disease package is attractive, especially for sowing on their high-rainfall farm in Dalyup. Using their usual disc set-up, they did not sow faba beans deep enough in 2020 so will have to look at ways to improve seeding depth in future seasons. In the long term, they would be interested in seeing trials of intercropping to harvest both canola and faba beans.

Morcombe – Faba beans: A pulse all-rounder to fit where lupins and field peas do not

King Yin Lui, DPIRD Esperance

SNAPSHOT

Growers: Brendan ‘Shorty’ Morcombe
Location: Scaddan
Enterprises: Wheat, barley, canola, faba beans
Growing season rainfall: 2020: 195mm
Years growing beans: 2
Typical rotation: Faba beans/pulse, wheat, canola, barley

Paddock set-up 2020

Soil type	Sandy loams, clay loams. pH($CaCl_2$) 5.1 – 6.7
Variety	PBA Samira, Gaucho treated
Seeding rate	120 kg/ha, 12–18 plants/m^2
Row spacing	30 cm
Seeding date	Dry sown on 5 April (opening rains 19 April)
Inoculant	Peat
Nutrition at seeding	MAP @ 70 kg/ha
Broadleaf herbicide strategy	propyzamide, trifluralin; trialled in 2020 Terbuthylazine (e.g. Terbyne®)

Underperformance of lupins and field peas a catalyst for adopting faba bean

Shorty Morcombe first trialled faba beans in 2018 and was pleased with the yield and response seen in the following cereal and canola crops. Shorty has also trialled field peas (two seasons) but was disappointed with their performance (yielding less than 1t/ha) and has decided to stop growing them for now. He has tried lupins, which yield well compared to field peas and faba beans in good years, but they are better suited to the sandier soil types found on the farm.

Despite below average rainfall, the 2020 season turned out to be an above average year in terms of cereal and canola yield. However, Shorty expected the faba beans to perform better, based on the large early biomass and good yields from the other crops. The faba beans yielded 2.1t/ha in 2020 and 2.4t/ha in 2018. In the paddock sown to faba beans in 2020, the poorest performing area of the paddock had a sandier soil type, pH($CaCl_2$) 5 to 20cm and depth to clay of approximately 40cm, compared to the rest of the paddock, which had a shallower depth to clay (20cm) and neutral pH. Poor early vigour and yellowing leaves in this poor patch prompted Shorty to trial extra N there to give the faba beans a boost, even though inspecting the roots when the N was applied showed reasonable nodulation. By harvest, he did not notice a significant yield response to the N applied; that area was still noticeably the worse performing area of crop. In previous years when lupins were cropped on the same paddock, they performed worse than beans overall; conversely, where faba beans performed badly, the lupins performed well. This pattern reflects the soil type response of the two crop types.

Figure 12.14: Yellowing on sandy, more acidic area of the paddock prompted Shorty Morcombe to apply urea in mid-July (when this photo was taken).

Figure 12.15: Soil cores (0–60cm) taken in two areas of the paddock.

(A) Clay loam soil type is the predominant soil type on the paddock and is more suited to faba beans than (B) sandy loam soils that are the better performing areas for lupins grown on the same paddock.

Photo courtesy of Aiden Sinnott, VRT Solutions.

Benefits to the rotation and sowing program

In 2019, Shorty saw a 500kg/ha yield benefit to Scepter wheat on areas where faba beans were sown in 2018 (2.4t/ha); in 2020 he thinks canola sown on the same area was better too, by about 100kg/ha.

A dry start to 2020 meant that faba beans gave him an opportunity to start the sowing program early, sowing them deep. He had initially tried to sow canola dry but had difficulty getting the depth right so made the switch to faba beans.

Weed burden and herbicide options

Shorty would like to take full advantage of the additional herbicide options available the next time he sows faba beans. He would consider a double knock with glyphosate and paraquat to control weeds and would desiccate the crop just to control wireweed. In 2020 he applied only paraquat — it suppressed the wireweed but he still had to follow up with herbicide straight after harvest. He will trial fomesafen (Reflex®) for radish and wireweed control; trifluralin does not give him enough residual control and only suppresses the main weed species present. He continues to see the benefit of being able to use the full rate of butroxydim (e.g. Factor®) for clethodim-resistant ryegrass.

Optimising fungicide inputs a priority to get right for the future

Because he was in the early stages of trialling faba beans and expected better performance based on early biomass, he applied tebuconazole with grass-selective herbicide and prothioconazole/bixafen (Aviator Xpro®) at early flowering. Dry and hot conditions during spring were not conducive to disease and contributed to reduced pod-set, thus contributing to the poorer-than-expected yield. Fungicides are a major cost when growing faba beans — Shorty would like to get better at the timing and optimal use of fungicides so he doesn't waste money on unnecessary applications, as well as get the best efficacy and yield protection from high-end fungicides. Ideally, he would like to reduce fungicides to one well-timed fungicide at vegetative/ early flowering and a second with a late budworm spray in seasons with high yield potential.

Mitigation of harvest losses off the header front

Although Shorty is currently direct heading, he is interested in the option of swathing canola and barley to get the most value from the header, optimising harvest timing across the program and mitigating risk from wind events during harvest. He would like to investigate if there is added benefit to swathing faba beans to mitigate harvest losses and thus get greater long-term value from the investment.

What would you change next year and in the longer term?

Shorty would consider increasing the seeding rate from 100 to 120kg/ha to achieve a greater plant density after discovering that the density was lower than the current recommendations. GRDC GrowNotes recommends 30 plants/m^2, while he achieved 12–18 plants/m^2.

Figure 12.16: High biomass faba beans in 2020.

Photo taken in September 2020; courtesy of Aiden Sinnott, VRT Solutions.

Perks – More reliable pricing and potential options for weed control

Emma Pearse, DPIRD Esperance

SNAPSHOT

Growers: Adrian and Kristen Perks
Location: Condingup
Enterprises: Canola, lupins, faba beans, wheat, and barley
Growing season rainfall: 2020: 355mm
Years growing beans: 2
Typical rotation: Wheat, barley, break crop (canola, faba beans, or lupins)

Paddock set-up 2020

Soil type	5–5.5 pH, sandy soil, prone to waterlogging pH($CaCl_2$) 5–5.5
Variety	PBA Samira and PBA Bendoc
Seeding rate	100 kg/ha
Row spacing	30cm
Seeding date	Sown into moisture on 20-25 April (opening rains 19 April)
Seeding set-up	Same set-up as rest of seeding operation
Inoculant	5-10 kg/ha ALOSCA® granules mixed with fertiliser
Nutrition at seeding	15 kg/ha P (by using MAP)
Broadleaf herbicide strategy	Only terbuthylazine (e.g. Terbyne®) IBS on the PBA Samira paddocks
In-season nutrition	80 kg/ha urea

2020 in-season management

	Target	Input
Fungicides	Chocolate spot	Tebuconazole
Insecticides	Budworm	Gamma-cyhalothrin (e.g. Trojan®)
Desiccation/Crop-topping	Various weeds	Glyphosate and paraquat

Faba beans new to the system

The Perks family is currently in the second year of growing faba beans and still unsure if they will remain in the program for the next few seasons. Currently, the Perks block sow either canola, lupins or faba beans as their break crop on each different block to fit into a wheat, barley, break crop rotation. Faba beans could provide an alternative crop in their program, particularly as they would be able to sow deeper and earlier than they can with lupins and canola.

Reliable marketing opportunities over lupins

The Perks can grow lupins very well; however, they do not see a great economic incentive if they can grow faba beans just as well when lupin prices are not consistently high enough. They will continue to grow faba beans if beans reliably yield an average of 2t/ha. The market benefits (price and reliability) compared to lupins are so positive for them that even if the beans do not nodulate well it is still economical to apply N to maintain an average 2t/ha yield. Economically, adding N in season to the faba beans works out similarly to canola; however, Adrian Perks gets the added benefit of some residual N in faba bean paddocks. That said, lupin prices for the 2020 season were high and selling to local feedlots was an attractive and simple option. The faba bean price did not carry huge incentives in 2020, particularly for the Perks as their faba bean quality assessment led to a lower grading. If local feedlots had the confidence and ability to use and handle faba beans, this could open up more options for local growers.

Benefits to the following wheat crop

Adrian does not adjust nutritional inputs for the following wheat crop if comparing to a wheat after canola or wheat after wheat. This is because he hopes for additional improvement in yield and protein with the remaining soil N after the faba bean crop. Additionally, faba beans provide better stubble cover compared to canola as the Perks' paddocks can be susceptible to wind erosion events on their sandy soils.

Herbicide tolerance traits could be a game changer for weed control

With limited post-emergent herbicide options, broadleaf weed control is one of the biggest hurdles to growing faba beans as the Perks have heavy capeweed burdens on their land. Currently PBA Samira has a good agronomic package for the area but cannot get on top of broadleaf weeds. Adrian thinks that if he can bulk up enough PBA Bendoc in the 2020 season and if the agronomy package suits the area, then sowing this variety will be a good option to help with weed control. Because PBA Bendoc is an IMI-tolerant line, this could allow the Perks more in-season herbicide options for better broadleaf weed control. They are very interested in trying new pre-emergent herbicide fomesafen (Reflex®) or existing flumioxazin (Terrain®) IBS and PSPE to target broadleaf weeds. Ideally, they would apply either of the pre-emergent herbicides both IBS and PSPE to get weeds between and in furrows.

Issues with waterlogging arising from poor nodulation

The location of the Perks' farm makes it prone to waterlogging. Among grain legumes, faba beans are known to have the best tolerance to waterlogging, and hence are a good choice for the area. Despite this, Adrian found that they nodulated very poorly early in the 2020 season and the plants did not recover well from waterlogging (Figure 12.15). In fact, all other crops surrounding the faba beans seemed to withstand the waterlogging much better. Adrian noticed some improved nodulation later in the season, likely due to the faba beans being N limited after the period of waterlogging. He thinks that if there had been good nodulation earlier the beans would have been able to cope better with the waterlogged conditions. This is a key issue that he would like to address going into the 2021 season where he will trial banding liquid inoculum (peat mixed with water) below the seed where roots will grow.

Figure 12.17: Waterlogged area with reduced establishment and biomass of faba beans and high weed population.

Wandel – Where to next for long-time faba bean grower

King Yin Lui, DPIRD Esperance

SNAPSHOT

Growers: Mark Wandel
Location: Scaddan
Enterprises: Wheat, canola, barley, faba beans
Growing season rainfall: 220mm
Years growing beans: since 2003 on current system
Typical rotation: Legume (faba beans/field peas/vetch), wheat, canola, wheat, barley

Paddock set-up 2020

Soil type	Sandy loams, loams. pH($CaCl_2$) 5-8
Variety	PBA Samira
Seeding rate	150 kg/ha
Row spacing	75 cm
Seeding date	Dry sown on 10 April (opening rains 19 April)
Seeding set-up	Rolled
Inoculant	ALOSCA® granules
Broadleaf herbicide strategy	Terbuthylazine (e.g. Terbyne®) PSPE

2020 in-season management

Fungicides	Prothioconazole/bixafen (Aviator Xpro®) over the crop using shielded sprayer during early flowering Mancozeb applied early podding Usually does one extra at pod-fill but not this season due to dry Spring conditions.

Long-time dedicated faba bean grower

Mark Wandel has been growing faba beans with their current system since 2003, after foliar disease made cropping them too risky in the 1990s. Better varieties and agronomy has meant faba beans are now a reliable inclusion in the rotation, so much so that he now has a dedicated 18m seeder bar and shielded sprayer to assist with growing faba beans. The seeder bar allows for 75cm row spacing, which improves airflow to decrease disease risk, seeds to depth at a rate of 130kg/ha, and bands fertilisers.

Integrated disease control through wide-row spacing with added weed control benefits

The adoption of wide-row spacing presents a weed management challenge as the faba bean crop provides little competition to in-season weeds (Figure 12.18). Mark uses a dedicated shielded sprayer that allows him to apply broad-spectrum herbicides in the inter-row for weed control and achieve better fungicide coverage by using the hooded sprayer to spray on-row. He also uses a high water rate and is willing to pay more for more efficacious fungicide chemistry.

Figure 12.18: Wide rows spaced at 75cm adopted as part of an integrated disease management strategy.

Tips for harvesting faba beans

Having rolled paddocks and flex draper fronts allows him to cut low, thus minimising harvest losses off the front. The Wandels use draper fronts as the top auger on the front is better at feeding tall crops through to the header as opposed to using the air reel that has trouble feeding up big crops. To minimise losses and discolouration they also harvest faba beans early in the harvest program before they get too dry and brittle, although too many still end up on the ground. Mark estimates they get about 200–300kg in losses off the header front.

Long-term average yields achieved despite dry season in 2020 and helped by lower input costs

A dry season causing drought stress, paired with strong winds, caused some necking of faba beans although these conditions have also meant that disease pressure was low and input costs reduced. This meant Mark did not apply as many fungicides as usual. He applied Prothioconazole/bixafen (Aviator Xpro®) at early flowering and followed it up with mancozeb at mid-flowering. He would usually apply a third foliar fungicide during pod-fill but did not need to due to the dry spring season and lack of disease inoculum. Overall, Mark is pleased with how his faba beans performed in 2020 — they yielded 2.2t/ha, which is about the long-term average, and he also spent less on fungicides.

In 2020, the timing of crop maturity and weed growth stage was ideal for using a double-knock strategy to manage weeds and desiccate the crop without compromising either weed control or grain quality. He applied glyphosate first and followed with paraquat four days later and is on track to achieve grade 1 faba beans.

Future directions

Having used wide rows for 17 years, Mark will trial conventional row spacing to confirm that wide rows are still the best way to crop faba beans. With new varieties, herbicides and crop protection chemicals available, he wants to check before he invests further in the wide-row system. He plans on sowing new variety PBA Amberley, which has better disease resistance and necking tolerance than older varieties and might be suited to conventional rows. In his current wide-row set-up, he gets 3–4t/ha in top-end yield and wonders if he could achieve that consistently with newer varieties and conventional sowing (and planting density), such as that achieved in the traditional faba bean growing regions of South Australia.

Conventional rows will limit the in-season herbicide options available because he will not be able to use the shielded sprayer. He will also trial herbicides flomesafen (Reflex®), carbetamide (Ultro®) and propyzamide.

When asked where he would like to take the system next, Mark said that in the longer term he would like to see precision planting of faba beans developed and trialled as a way to get improvements in even distribution of plant numbers and spacing across the paddock. Mark realises it may be far off but, with improving technology demonstrated in other crop types, he is interested in seeing the technology engineered to sow faba beans too.

Figure 12.19: Hooded sprayer used by Mark Wandel to apply herbicides between rows and fungicides and insecticides on-row.

Photo courtesy Jo Wheeler.

Warakirri – Incorporating legumes in a corporate farming operation

Emma Pearse and King Yin Lui, DPIRD Esperance

SNAPSHOT

Growers: Warakirri Cropping – Lobethal (Dave Cook)
Location: Condingup
Enterprises: Wheat, barley, canola, faba bean, lupin, chickpea
Growing season rainfall: 2020: 281mm
Years growing beans: 3
Typical rotation: Legume, canola, wheat, barley, canola, wheat

Paddock set-up 2020

Soil type	Sandy to loamy clay. pH($CaCl^2$) 5.2 – 6
Variety	PBA Samira
Seeding rate	100 kg/ha
Row spacing	27.9cm (11 inch)
Seeding date	Sown into moisture on 27 May (opening rains 19 April)
Seeding set-up	Tyne
Inoculant	ALOSCA® granules, though moving away from that into TagTeam® granules
Nutrition at seeding	MAP TE
Broadleaf herbicide strategy	No in-season herbicide applied
In-season nutrition	Zn and Mn

2020 in-season management

	Target	Input
Fungicides	Chocolate spot	Mancozeb
Insecticides	Native budworm, RLEM	Alpha-cypermethrin
Desiccation/Crop-topping	Various weeds	Double-knock glyphosate then paraquat

Introducing legumes into the farming system

Warakirri Cropping is a corporate-owned farming enterprise located in a high-rainfall area east of Condingup. Originally, the group farmed a rotation of wheat, barley and canola. Although this rotation was profitable, they became aware that they would need a legume in the system to sustain profits over the long term. Employing staff from interstate, where crop rotations are more diverse, came the knowledge of how short cereal–canola rotations can lead to problematic disease carryover, particularly in a high-rainfall area with heavy stubble residues. In 2017 they trialled different pulses to see how they could fit into the system, starting with a 20ha area of faba beans on their heavier, waterlogged soil, and have grown legumes every year since. The inclusion of pulses in their system has created diversity in the rotation, improved soil nutrition and aided weed control.

Warakirri now incorporates lupins, chickpeas and faba beans into the system. The farm's cropping rotation comprises 1/3 wheat, 1/3 canola and 1/3 legumes/barley. Because Warakirri is a corporate farm, decisions must be profit-driven in the year of production. Introducing pulses into the rotation required proven improvements to the cropping system plus economic returns to the company, which have been successfully achieved each year in three years of growing pulses.

Although improving soil nutrition was a reason for incorporating legumes into the system, they currently do not change nutrient inputs to the crop in the following year. Continual improvements to soil moisture utilisation and yield improvements across the operation means Warakirri still sees a yield benefit from the legume-fixed N and there is no economic incentive at this stage to reduce N fertiliser in the crop following pulses.

Different legume species in the system to suit conditions

The Warakirri property spans various dominant soil types and topography and the growing season rainfall ranges from 450mm in the north to 550mm in the south. The vast difference in rainfall and soil types has meant they can grow three different legume species — chickpeas, lupins and faba beans. Faba beans are targeted on the heavier soils that have less undulation and where waterlogging is more likely to occur. Chickpeas and lupins are grown on better-drained soil.

Although faba beans can withstand some waterlogging, areas exposed to water for lengthy periods of time in the 2020 season struggled and brought down the average yield to an overall average of 2.8t/ha, with top-end yields reaching approximately 5t/ha. Faba beans were sown on soils with high clay content and this paddock was not included in their ripping program. Conversely, much of the farm is deep ripped every other year to combat compaction and waterlogging and gypsum is spread on areas where deep ripping is not possible.

Legumes to include for a double break to control weeds

Another benefit of pulses in the rotation is the ability to have a double break (legume followed by canola) to help control grass weed populations. Canola will always be grown after a legume crop, and not before, to reduce pressure from volunteer canola in the legume year. Of the three legumes grown in 2020, weeds were hardest to control in chickpeas due to their poor early-season competitiveness, while lupins were the most competitive. Faba beans, which were sown on a different soil type and on a higher-rainfall block, had a different weed spectrum, which was very hard to control in areas of severe waterlogging. However, the faba beans mostly out-competed weeds in areas not affected by waterlogging.

What is next?

Warakirri is keen to get more on-farm storage to retain seed for longer periods if markets are down in the year of growing them. As legume prices can fluctuate greatly, it will be important for the company to hold on to grain until it can ensure good profits. Currently faba beans are stored in the large grain shed and in grain bags in the paddock, which is not ideal for long-term storage (Figure 12.20).

Warakirri is also keen to try different sowing densities, particularly increasing the sowing rate to encourage pod-set higher up the plant. This will result in better harvesting conditions and less seed lost in front of the header. The staff would also like to try different header fronts to improve harvesting but this is difficult because they use contract harvesters.

Figure 12.20: Dave Cook, Warakirri Lobethal farm manager, and King Yin Lui, DPIRD, with grain bag of faba beans from the 2020 harvest.

Figure 12.21:
PBA Bendoc Faba beans growing on a forest gravel at Ben Webb's in Muradup, 2020

Webb – Faba beans on forest gravel soils

Sarah Belli, DPIRD Albany

SNAPSHOT

Growers: Ben & Emily Webb
Location: Muradup
Enterprises: Cropping and sheep
Growing season rainfall: Average 530mm (2020: 391mm)
Years growing beans: 5
Typical rotation: Beans, barley, hybrid canola, wheat, hybrid canola/lupins, oats

Paddock set-up 2020

Soil type (pH, texture)	Forest gravel. pH($CaCl_2$) 5.1–5.9
Variety	PBA Bendoc
Seeding rate	140 kg/ha (aiming for 30 plants/m^2)
Row spacing	22.9 cm (9 inch)
Seeding date	Sown into moisture on 2 May (opening rains 6 May) Grower aims to get them in earlier
Seeding set-up	Morris seeding bar with knife points and closing plates
Inoculant	ALOSCA® granules with fertiliser EasyRhiz™ at 50 L/ha water rate (in-furrow injection with 2L/ha SE14®)
Nutrition at seeding	50kg/ha potash spread in summer 100kg/ha MAPSZ® + 8 kg/ha Mn sulphate
Broadleaf herbicide strategy	Imazamox/Imazapyr (e.g. Intercept®)
In-season nutrition	Zn 200mL + Mo 5g + Mn 500mL pre-budding

2020 in-season management

	Target	Input
Fungicides	Chocolate spot	Tebuconazole/ azoxystrobin (Veritas®) at pre/early flowering; mancozeb + carbendazim later
Insecticides	Budworm	Gamma-cyhalothrin (Trojan®) at desiccation
Desiccation/Crop-topping	Various weeds	Paraquat

Background

Ben and Emily Webb's family mixed crop and sheep farm is west of Kojonup. The Webbs crop wheat, barley, canola, oats, lupins, faba beans and vetch. They first started growing faba beans five years ago and have included them in the sowing program every year since. The dominant soil type in this region is forest gravel (Figure 12.21), which is often non-wetting and can fix P and N, resulting in deficiencies. Their motivation behind growing faba beans is to increase organic N in the soil, to provide a root disease break (nematodes and rhizoctonia) and offer alternative chemical options for weed control. Ben finds beans can handle the wetter areas of the farm better than lupins can.

Pre-faba bean crop

Liming - One of Ben's tips for successfully growing faba beans is to get the pH right by liming adequately. Over the past 20 years, he has applied 6–7t/ha of lime to the paddock where the PBA Bendoc faba beans grew. However, in 2020, the lime hasn't been incorporated due to the soil type. The pH($CaCl_2$) ranges from 5.1 to 5.9. He applies 1t/ha the year before canola in paddocks that have good pH but will increase the rate to 2t/ha in paddocks with more acidic pH levels.

Paddock preparation - With the addition of sheep in his farming system, summer weed management is not considered a big problem. A mix of terbuthylazine (e.g. Terbyne®), propyzamide, and diuron is used pre-emergent in paddocks going into faba beans.

Post-faba bean crop

The crop sequence following faba beans could be barley, canola (hybrid), wheat, canola or lupins, then oats. However, his agronomist recommended rotating beans then wheat for frost management and organic N utilisation. He no longer reduces the N rate following a faba bean crop, as he had in previous years, and acknowledges that there is more potential yield. A typical N application is 100–120kg/ha of N for barley. Ben has some storage on farm for beans and trucks them to Perth in early January.

Looking forward

Ben is excited by the development of acid-tolerant rhizobia coming to market as he believes it will be useful for Kojonup growers. He would like to try a shielded sprayer.

Research gaps

The Webbs identified a major challenge was controlling broadleaf weeds in crop. Although he grew PBA Bendoc in 2020, he says a variety that has IMI tolerance as well as better disease resistance (such as PBA Amberley), would be a great step forward. Controlling disease is another challenge for the Webbs at their high-rainfall farm. Chocolate spot heavily infected parts of the paddock in 2020 and caused lodging in some areas where the plants were growing thin and tall.

Wood – Disease management a challenge in high-rainfall zone

Carla Milazzo, DPIRD Albany

SNAPSHOT

Growers: Jeremy Wood
Location: Kendenup
Enterprises: Mixed crop and sheep
Growing season rainfall: 400mm (2020: 330mm)
Years growing beans: 6
Typical rotation: Wheat, canola, barley, faba beans or field peas

Paddock set-up 2020

Soil type (pH, texture)	Forest gravels, gravelly loams, clay loams. Surface 0–10 cm pH($CaCl_2$) between 5 and 6.
Variety	PBA Samira
Seeding rate	140 kg
Row spacing	35.6 cm (14 inch)
Seeding date	Dry sown on 3 May (opening rains 6 May)
Seeding set-up	Disc seeder that seeds the entire program, no adjustments needed. Fertiliser below the seed, which goes in 5 cm.
Inoculant	Peat inoculant
Nutrition at seeding	Superphosphate
Broadleaf herbicide strategy	Pre-emergent – Terbuthylazine (e.g. Terbyne®) hand weeding radish, and crop-topping.
In-season nutrition	None

2020 in-season management

	Target	Input
Fungicides	Chocolate spot	Three fungicides various modes of action
Insecticides	Budworm	Cypermethrin
Desiccation/Crop-topping	Radish, grasses	Paraquat

After seeing a friend try faba beans and deciding to give them a chance six years ago, the Woods have a good idea of how to grow faba beans successfully. Price and market volatility hold them back from sowing beans over more of their cropping program, however they manage risk by storing and feeding grain legumes to their sheep when legume prices are unfavourable for sale.

Legumes are important in the rotation

In 2020 the Woods sowed 60ha to PBA Samira faba beans. Jeremy Wood says they like to grow faba beans on their heavier country, reserving the more gravelly paddocks for their other crop legume, field peas. They use surface liming to increase the pH($CaCl_2$), aiming for 5.5 in the topsoil before attempting to grow faba beans. Jeremy says pH is the most important thing to get right before starting. Compared to field peas, faba beans are typically more profitable for the Woods due to their higher yield and excellent prices in recent years. They decide whether to sell their faba beans and field peas or retain them for sheep feed depending on their relative prices. For example, in the 2020/2021 harvest period, unlike in previous years, they sold field peas at good prices and stored faba beans to feed sheep. They aim to grow a legume every four to five years in their rotation with wheat, barley, and canola. Jeremy says he has noticed better yields and higher protein in wheat following faba beans, though they do not reduce N for that crop. He says Scepter wheat usually struggles to make high protein, so the extra N from legume residues has been beneficial.

Managing inoculation and weed control at seeding

Jeremy uses peat to inoculate faba beans, which they sow with a disc seeder. Although seeding depth is limited to around 5cm, they avoid dry sowing unless rain is forecast within 24–48 hours to optimise rhizobia survival. Jeremy is very satisfied with the nodulation using this method, as long as the season breaks reasonably early. Fertiliser is placed below the seed at seeding and usually no follow-up nutrition is required. Jeremy uses terbuthylazine (e.g. Terbyne®) pre-emergent to suppress broadleaf weeds. Because wild radish has often matured and shed seed by the time the crop is ready to desiccate, they do some hand weeding and then crop-top with paraquat to clean up any grasses still setting seed.

Focusing on disease management

Disease management has been their main challenge, especially chocolate spot, which can take off quickly. Jeremy says that fungicides are a major variable cost for them but he doesn't want to risk not spraying, as losing yield is costlier. This season the faba beans were sprayed three times, with an insecticide to manage budworm added to the final spray. Jeremy has observed PBA Samira's increased resistance to chocolate spot but this variety has greater susceptibility to ascochyta blight compared to the variety he has grown previously, Fiesta VF. As disease management is one of the main challenges in their high-rainfall environment, PBA Amberley, the recently released and most disease-resistant variety yet, is of interest for the future. Jeremy appreciates that far more fungicide options are available today than in previous decades; however, more work could be done in spray decision support so growers can avoid over-spraying and have greater confidence in their decisions.

Managing snails with faba bean

Another challenge in their high-rainfall environment is managing grain contamination from small conical snails. Jeremy says snails have not been an issue in the faba beans like they are in canola and cereals - so far. They are baiting, bashing, and burning windrows after canola to reduce snail numbers. However, they still need to clean all their canola and sometimes their cereals to meet the tight grain receival standards.

List of shortened forms

APVMA	Australian Pesticides and Veterinary Medicines Authority
DBS	Deep bursting plate (refers to knife-point seeding systems)
DDLS	DPIRD Diagnostic Laboratory Service
DPIRD	Department of Primary Industries and Regional Development
ET	Economic threshold
GRDC	Grains Research and Development Corporation
GSR	Growing season rainfall (generally April to October)
IBS	Incorporated by sowing
IMI	Imidazolinone (chemical group of herbicides – Group B)
MAP	Mono-ammonium phosphate
N	Nitrogen
PBA	Pulse Breeding Australia
PSPE	Post-sowing pre-emergent
RLN	Root lesion nematode
RLEM	Redlegged earth mite
RRA	Regional Research Agronomy. The short title of the GRDC project DAW00256 that the authors belong to at DPIRD.
SARDI	South Australian Research and Development Institute
SEPWA	South East Premium Wheat Growers Association
WHP	Withholding period

Glossary of Terms

Break crop	A crop sown to manage disease, weed and pest levels in a crop rotation. In this context pulse and oilseed crops are considered break crops in cereal-dominant production systems.
Crop-topping	The late application of a broad spectrum herbicide (such as glyphosate) to sterilise weed seeds that are maturing with the crop, to reduce weeds in the next growing season.
Decile (rainfall)	Deciles give a ranking to rainfall compared with the average for that area. Deciles are normally discussed in terms of summer rainfall or growing season rainfall. The lowest 10% of rainfall totals on record are in the decile 1 range. The highest 10% of rainfall totals are in the decile 10 range, so they are higher than 90% of rainfall records.
Desiccate	The process of aided crop ripening, in this instance by applying a herbicide before harvest. This accelerates crop death and causes more even ripening across the paddock.
Green-bridge	The term ‘green-bridge’ describes the role of weeds and crop volunteers in hosting pests and diseases that threaten crops from one growing season to the next.
Inoculate	The process of introducing root nodulating bacteria (rhizobia) to legume seeds.
Lodging	When plant stems permanently bend or buckle causing the crop to ‘fall over’. This impedes crop ripening and also makes the crop difficult to harvest. Strong winds and rain, and diseases can cause lodging, especially in tall crops.
Knockdown	The use of a non-selective herbicide (such as glyphosate) that kills all plants and weeds when used correctly, usually applied before seeding a crop.
Necking	Similar to lodging but stems bend sharply, almost snapping off, often halfway up the stem or at pod-height.
Nodulate	The formation of ‘nodules’ on legume that host nitrogen fixing bacteria. Nitrogen fixation occurs in healthy, pink nodules.
Prophylactic	Preventative. In this context, prophylactic fungicide sprays or ‘insurance sprays’ are applied before disease is observed.
Rhizobia	Nitrogen-fixing soil bacteria (usually introduced through inoculation) that form symbiotic relationships with legumes. Rhizobia form root nodules and fix atmospheric nitrogen into plant-available nitrogen.
Selection Pressure	External agents that affect an organism’s ability to survive and reproduce to pass on its traits. In this context, pesticides are selection pressures that increase the ability of resistant individuals (in a population of weeds, insects or disease-causing microbes) to survive and pass on resistance traits.
Volunteer	Crop plants that grow without being deliberately sown. Usually volunteers appear from shed or spilt grain from the previous season’s crop.