SOUTHERN

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GRDC

GROWNOTES™

GRDC GRAINS RESEARCH & DEVELOPMENT CORPORATION

FABA BEAN

SECTION 9

DISEASES

KEY POINTS | IMPACT AND COST OF DISEASES | INTEGRATED PEST MANAGEMENT (IPM) STRATEGIES | SELECT A RESISTANT VARIETY | PADDOCK SELECTION | GOOD HYGIENE | USE CLEAN SEED | SOWING | RISK ASSESSMENT | SYMPTOM SORTER | CROP MONITORING | FREE ALERT SERVICES FOR DISEASES | USING FUNGICIDES | CORRECTLY IDENTIFYING DISEASES | ASCOCHYTA BLIGHT | CHOCOLATE SPOT | RUST | CERCOSPORA LEAF SPOT | ALTERNARIA | SCLEROTINIA STEM ROT | BOTRYTIS GREY MOULD (BGM) | APHANOMYCES ROOT ROT | OTHER ROOT ROTS | STEMPHYLIUM BLIGHT | STEM NEMATODE | ROOT-LESION NEMATODES (RLN) | VIRUSES | EXOTIC DISEASES WITH POTENTIAL TO IMPACT ON AUSTRALIAN CROPS

Diseases

Key points

- Faba bean need good disease management to protect yield and ensure a quality, blemish-free seed product.
- Key diseases in the southern region are chocolate spot, Ascochyta blight and Cercospora leaf spot. Rust can be a problem in prolonged wet seasons.
- Avoid growing susceptible varieties and practice sound agronomic management to minimise the risk of disease. Use a 4-year break between bean crops and sow at least 500 m from other bean crops or bean stubble.
- Crop monitoring for disease is essential. There are three critical periods for fungicide application. Accurately identify disease to choose the appropriate fungicide.
- Disease pathogens can mutate and overcome resistance. Monitor all varieties regardless of resistance rating.

Disease management is essential for successful faba bean production. Failure to manage diseases effectively can lead to substantial yield loss and damage to quality reducing the value of the grain.

Faba bean requires a high level of disease management to keep the product blemish-free, particularly during the podding stage.[1] The high market value of a quality product in the human food market means the effort will be rewarded.

Bad experience with disease epidemics in the past and the effort required to manage disease has led some growers to discontinue growing beans. However, crops are now more robust as newer varieties have better disease resistance and there have been improvements in disease management packages (i.e. fungicide and canopy management).

The major fungal diseases affecting faba bean in the southern region are chocolate spot, Ascochyta blight and Cercospora leaf spot.[2] Rust can become an issue in prolonged wet seasons.

These diseases can be effectively controlled to prevent them from causing yield loss. Management decisions and seasonal conditions play a significant role in disease outbreaks and grain yield. Bean growers need to take an integrated approach to disease management in most years to produce a profitable crop.

Growing resistant varieties in an integrated disease management program remains the most effective method of control. Breeding new varieties is a major focus of the Australian pulse breeding program.[3] The breeding program has identified good sources of resistance to Ascochyta blight, rust, Cercospora leaf spot and Bean leaf roll virus (BLRV). Many breeding lines have resistance to at least two and often three of these diseases.

Dramatically improving varietal resistance to chocolate spot remains problematic due to complicated genetics. Resistance sources exist mainly in varieties that are poorly adapted to Australia, and there is the difficulty of screening in the field.

9.1 Impact and cost of diseases

A 2012 GRDC study reported that disease costs the Australian pulse industry an average of $74 million per year or 14.8% of the gross value of pulse production.[4] Losses would be far higher without the current range of controls, which include the use of resistant varieties, rotation, paddock management and the use of fungicides.

In the Australian faba bean industry, disease causes an estimated current average annual loss of $4.4 million, or $31.43 per hectare. This is 10.6% of the average annual value of the crop. Most faba bean crops (97%) are treated with foliar fungicides at an average cost of $55/ha per year.

In the southern region the most important bean diseases with a yearly incidence of 25% or more were Ascochyta blight, Cercospora leaf spot, chocolate spot, Botrytis grey mould and Cucumber mosaic virus (CMV). These diseases (except for CMV) are also the ones that occur most widely in southern Australia.

In 2010 the value of disease resistance was emphasised when above-average rainfall resulted in widespread disease epidemics:

- Chocolate spot occurred throughout the southern and northern regions.
- There was potential for severe seed staining due to Ascochyta blight in the southern region.

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1 K Lindbeck (2014) Faba bean and chickpea disease management. GRDC Update Papers, 31 July 2014, https://grdc.com.au/resources-and-publications/grdc-update-papers/tab-content/grdc-update-papers/2014/07/faba-bean-and-chickpea-disease-management

2 Pulse Australia (2016) Faba bean: Integrated disease management. Pulse Australia website, http://www.pulseaus.com.au/growing-pulses/bmp/faba-and-broad-bean/idm-strategies

3 J Paull (2011) UA00097 Australian Faba Bean Breeding Program 2007-2011. Project Final Report, University of Adelaide, https://grdc.com.au/research/reports/report?id=1485

4 GM Murray, JP Brennan (2012) The current and potential costs from diseases of pulse crops in Australia. GRDC Report, https://grdc.com.au/resources-and-publications/all-publications/publications/2012/06/the-current-and-potential-costs-from-diseases-of-pulse-crops-in-australia

FEEDBACK

MORE INFORMATION

Pulse Australia has information on Faba bean IDM, please see http://pulseaus.com.au/growing-pulses/bmp/faba-and-broad-bean/idm-strategies

- Cercospora leaf spot was also widespread in the southern region, although it was not as damaging as other diseases.
- Rust was widespread in the northern region, and also present in the southern region.

9.2 Integrated pest management (IPM) strategies

Disease management in pulses is critical, and relies on an integrated management approach to variety choice, crop hygiene and strategic use of fungicides.[5] The initial source of the disease can be the seed, the soil, the pulse stubble or self-sown seedlings, or in some cases other plant species. Once the disease is present, the source is then from within the crop itself.

A plant disease may be devastating at certain times and yet, under other conditions, it may have little impact. The interaction of host, pathogen and environment are all critical in disease development and can be represented by the two disease triangles (Figures 1 and 2).

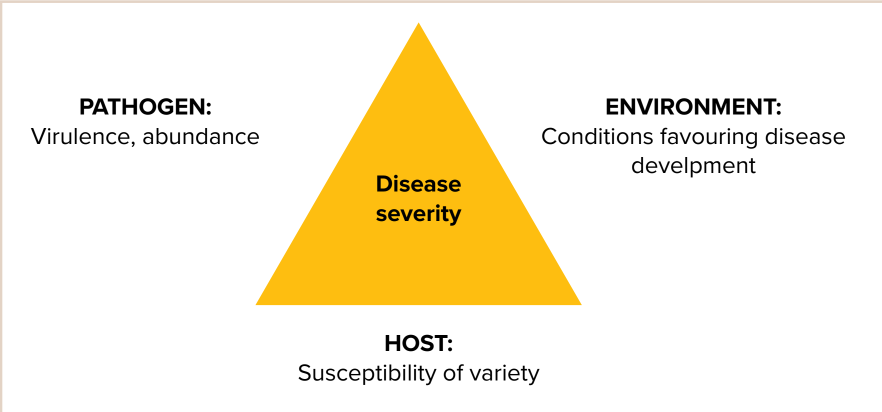


Figure 1: *Fungal disease triangle.*

Source: Agrios (1988)[6]

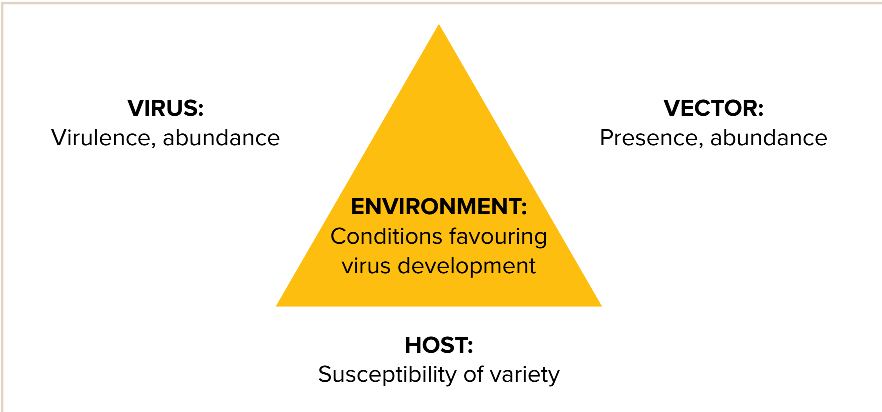


Figure 2: *Viral (and some bacterial) disease triangle.*

Source: Jones & Barbetti (2012)

Diseases such as Ascochyta blight and chocolate spot can cause total crop failures very quickly, whereas Botrytis grey mould and root-lesion nematodes can reduce vigour throughout the season, making it hard to judge their true impact on crop performance and yield.

5 Pulse Australia (2016) Southern faba & broad bean best management practices training course – 2016. Pulse Australia.

6 GN Agrios (1988) Plant Pathology (3rd edition). Academic Press, New York.

Where possible choose a pulse variety that is resistant to the most important diseases in your area. Choose a paddock with low disease risk based on rotation and proximity to other pulse crops. Strategic fungicide application is necessary to minimise disease impact. In high-risk situations, fungicide disease control strategies alone may not be sufficient, particularly if susceptible varieties are grown.

The key aspects to managing diseases in pulses are detailed Sections 9.3 to 9.10. In summary:[7]

- **Varietal resistance** – select a resistant variety.
- **Distance** – separate, by at least 500 m, from stubble of the same pulse from the previous year. This reduces infection for some diseases.
- **Rotation** – aim for at least a 4-year rotation between planting the same pulse crop. A high frequency of crops like lentil, faba bean, vetch, field pea, chickpea, lathyrus or clover pasture puts pulses at greater risk of multi-host diseases such as Phoma, Sclerotinia and Botrytis grey mould, and canola can increase the risk of Sclerotinia.
- **Hygiene** – practice hygiene by reducing last year's pulse stubble if erosion is not a risk and removing self-sown pulses before the new crop emerges.
- **Clean seed** – sow seed from crops with no disease or a low level, especially at podding. Avoid using seed where there was a known disease infection, particularly for susceptible varieties. Have seed tested for disease.
- **Fungicide seed dressing** – in high-risk situations seed dressings provide partial early suppression of diseases like Botrytis grey mould, Phoma and Ascochyta blight. They are not effective against viruses and bacterial diseases.
- **Sowing date** – do not sow too early to avoid excessive vegetative growth and early canopy closure. Early crop emergence may coincide with greater inoculum pressure from old crop residues nearby. Aim for the optimum sowing window for the pulse variety and your district.
- **Sowing rate** – aim for the optimum plant population (depending on region, sowing time, crop type, variety), as denser canopies can lead to greater disease incidence. Adjust the seeding rate according to seed size and germination.
- **Sowing depth** – sowing deeper than normal any seed lot that is infected with disease will help reduce the emergence of infected seedlings. The seeding rate must be adjusted upwards to account for the potential of a lower emergence and establishment percentage.
- **Foliar fungicide applications** – susceptible varieties require a more intense fungicide program. Success depends on timing, weather conditions that follow and the susceptibility of the variety grown. Monitoring for early detection and correct disease identification is essential. Correct fungicide choice is also critical.
- **Mechanical damage** – physical damage from excessive traffic, wind erosion, frost, hail, post-emergent rolling or herbicide damage can increase the spread of foliar disease in pulses.
- **Control aphids** – integrated pest management to reduce the incidence of aphids can reduce the spread of viruses. Spraying insecticide may assist, but is not always effective or and rarely economic. Usually the virus spread has occurred by the time the aphids are detected.
- **Harvest** – harvest early to minimise disease infection on seed. Consider windrowing or desiccation as a tool to enable earlier harvesting.

7 Pulse Australia (2016) Faba bean: Integrated disease management, Pulse Australia website, http://www.pulseaus.com.au/growing-pulses/bmp/faba-and-broad-bean/idm-strategies

MORE INFORMATION

GRDC Crop Variety Guides, https://grdc.com.au/resources-and-publications/all-publications/crop-variety-guides

The Crop Disease Au app is available at http://www.nvtonline.com.au/interactive-tools/apps/

9.3 Select a resistant variety

Selecting a resistant variety is the most effective method of disease control.[8] Other management practices are not always effective and can be expensive and highly dependent on seasonal conditions. Resistant varieties reduce the reliance on foliar fungicides.

The variety resistance ratings are defined as follows:

- Resistant (R) varieties – no economic yield loss is expected under average conditions. Control measures are unlikely to be profitable. Resistant varieties are not immune when conditions are conducive to disease.
- Moderately resistant (MR) varieties are expected to sustain low to moderate yield loss and control measures are likely to be cost effective.
- Moderately resistant to moderately susceptible (MR-MS) varieties are expected to sustain moderate to high losses and control measures are necessary to ensure a profitable crop.
- Moderately susceptible (MS) or worse varieties (susceptible (S), very susceptible (VS)) will sustain very high to total yield loss and control measures are essential to produce a harvestable crop.

No variety has resistance to all diseases of faba bean. Therefore, it is important to select the correct fungicide and application timing to best manage the target disease in the chosen variety. Control strategies vary according to the variety being grown.

In a wet season, such as 2010, when repeated cycles of infection occurred, even MR varieties can have yield reducing levels of disease.

Resistance can breakdown when there are disease incursions from overseas or there is high population pressure through frequent planting of varieties all relying on the same resistance gene.[9] For example, a new pathotype of Ascochyta blight with virulence against many previously resistant varieties was detected in the Mid North of South Australia in 2013 and has now spread to other areas.

The disease ratings in Table 1 are from early 2016. Always check the updated disease ratings each year in the current crop variety guides (see More Information) for each state or in the NVT Crop Disease Au app.

8 FL Stoddard, AH Nicholas, D Rubiales, J Thomas, AM Villegas-Fernandez (2010) Integrated pest management in faba bean. Field Crops Research, 115, 308–318 https://www.researchgate.net/publication/229612261_Integrated_pest_management_in_faba_bean

9 J Davidson, R Kimber, C Walela, L McMurray, K Hobson, J Brand and J Paull (2016) Pulse diseases in 2015. GRDC Updates Paper, 9 February 2016, https://grdc.com.au/resources-and-publications/grdc-update-papers/tab-content/grdc-update-papers/2016/02/pulse-diseases-in-2015

Table 1: Faba bean disease ratings.

Variety	Ascochyta blight Pathotype 1 (P1)	Ascochyta blight Pathotype 2 (P2)	Chocolate spot	Cercospora	Rust	PSbMV seed staining	*Pratylenchus thornei*
FABA BEAN							
Farah$^{\phi}$	RMR	S	S	S	S	S	MS
Fiesta VF	MR-MS	S	S	S	S	S	MS
Nura$^{\phi}$	RMR	RMR	MS	S	MS	VS	MS
PBA Rana$^{\phi}$	R	MR-MS	MS	S	MS	MR	MS
PBA Samira$^{\phi}$	R	RMR	MR-MS	S	MS	S	MR-MS
PBA Zahra$^{\phi}$	R	MR-MS	MR-MS	S	MS	S	MS
BROADBEAN							
Aquadulce	MS	MS	MS	S	MS	S	-
PBA Kareema$^{\phi}$	RMR	MR-MS	MS	S	MR-MS	S	-

Disease ratings from Pulse Breeding Australia.

Resistance order from best to worst: R > RMR > MR > MRMS > MS > MSS > S > SVS > VS

p = provisional ratings - treat with caution. R = resistant, M = moderately, S = susceptible, V = very

Source: Victorian Winter Crop Summary (2017), Department of Economic Development, Jobs, Transport and Resources, Victoria, https://www.grdc.com.au/NVT-Victorian-Winter-Crop-Summary

9.4 Paddock selection

Sow beans into standing stubble of previous cereal stubble to protect against rain-splash of soil-borne spores, protect against erosion and reduce attractiveness of the crop to aphids that can spread viruses.

Rotational crops and weeds

Allow 4 years between growing bean crops in the same paddock and at least 500 m (preferably more) distance from previous year's bean crop to minimise the inoculum for chocolate spot, Ascochyta blight, rust and Cercospora leaf spot.

Some diseases have potential for cross infection across more than one pulse crop (Table 2).

Table 2: Diseases occurring on pulses with potential for cross-infection

	Chickpea	Faba bean	Lentil	Lupin	Peas	Vetch
Botrytis grey mould (BGM)						
*Botrytis cinerea**	★★	★★	★★	★	★★	★★
Chocolate spot						
Botrytis fabae	★	★★	★★			★★
Cercospora leaf spot						
Cercospora zonta		★★				
Sclerotinia						
Sclerotinia sclerotiorium	★★		★★	★★	★★	
Sclerotinia trifoliorium	★★	★★		★★		
Bacterial blight						
Pseudomonas andropogonis	★					
Pseudomonas syringae pvv *syringae*		★★	★		★★	

	Chickpea	Faba bean	Lentil	Lupin	Peas	Vetch
Pseudomonas syringae pvv pisi					★ ★	
Ascochyta blight						
Ascochyta fabae		★ ★				★
Ascochyta lentis			★ ★			
Ascochyta pisi	★				★	★
Ascochyta rabiei	★ ★					
Phoma blight						
Phoma medicaginis var *pinodella*	★		★	★	★ ★	★ ★
Black spot (see also Phoma & Ascochyta)						
Mycosphaerella pinodes	★ ★	★	★		★ ★	★
Anthracnose						
Colletotrichum gloeosporoides				★ ★		
Brown leaf spot						
Pleiochaeta setosa				★ ★		
Grey leaf spot						
Stemphylium botryosum	★		★ ★	★ ★		
Downy mildew						
Peronospora viciae					★ ★	★
Powdery Mildew						
Erysiphe pisi					★ ★	
Septoria						
Septoria pisi					★ ★	
Phomopsis						
Phomopsis leptostromiformis				★ ★		
Rust						
*Uromyces viciae-fabae***		★ ★			★	★ ★
Root-lesion nematode						
Pratylenchus neglectus	★					
Pratylenchus thornei	★ ★					★ ★
Stem nematode						
Ditylenchus dipsaci	★	★ ★			★ ★	★
Viruses						
Bean yellow mosaic virus		★		★ ★		
Cucumber mosaic virus	★★	★	★ ★	★ ★		
Luteo viruses complex (e.g. BLRV & BWYV)***	★ ★	★ ★	★★	★	★ ★	★ ★
Pea seed-borne mosaic virus (PSbMV)±		★★			★ ★	
Alfalfa mosaic virus	★ ★	★	★ ★			★
Wilt						
*Fusarium oxysporum***				★ ★	★ ★	

	Chickpea	Faba bean	Lentil	Lupin	Peas	Vetch
Root rots						
Aphanomyces root rot (*Aphanomyces euteiches*)§		★★			★	
Fusarium	★	★	★	★	★	★
Macrophomina	★				★★	
Phytophthora medicaginis	★★					
Pleiochaeta setosa			★★			
*Pythium**	★		★	★	★	
Rhizoctonia	★	★★	★★	★★	★★	★★
Sclerotinia¥	★		★	★	★	

★ This disease occurs in this crop, but does not caused major damage.

★★ This disease has caused major damage to this crop.

* Pythium and Botrytis grey mould are worse (★★★) in white peas than dun peas (★★)

** Strain differences between crops.

*** Luteovirus complex on pulse crops consists of Bean leaf roll virus (BLRV), Beet western yellows virus (BWYV, syn. Turnip yellows virus, TuYV), Soybean dwarf virus (SbDV) and Phasey bean virus. Each of these viruses can be found on each of the pulse crops, but their impact varies between host species and regions.

± PSbMV causes seed markings on faba bean that can have a serious impact on price. However, as Australian PSbMV strains are only seed-borne in field pea, faba bean infections only occur if the crop is grown in the vicinity of PSbMV infected field pea crops.

§ Aphanomyces root rot has been identified as a cause of severe root rot on faba bean in commercial fields in NSW. So far it is not reported as a problem in Australian field pea, but it is considered a very serious field pea disease overseas.

¥ Sclerotinia (root rot) is worse (★★) in kabuli than desi (★).

Source: Pulse Australia (2016)[10]

Do not sow adjacent to lentil and vetch crops or stubble as these may harbour *Botrytis fabae*, the primary cause of chocolate spot in faba bean. If this is not possible manage as for high disease risk situations.

It is recommended to avoid a high frequency of other pulse crops, lathyrus or clover pasture as these can increase the risk of multi-host diseases such as Phoma, Sclerotinia and Botrytis grey mould.

The Botrytis grey mould pathogen (*Botrytis cinerea*) has a wide host range including lentil and weeds such as *Euphorbia* spp., groundsel and emu-foot. *Phoma medicaginis* var. *pinodella* can be hosted by lucerne, clover, field pea, lupin and chickpea, as well as *Phaseolus* spp.

Sclerotinia can be hosted by canola and most weed species.

Growers who plan to sow more than one variety of faba bean should ensure there is at least 500 m between different varieties. Faba bean cross-pollinate, increasing the risk of disease resistance breaking down and producing mixed seed types that are difficult to market.

Some of the viruses affecting faba and broad bean also have wide host ranges. Weeds, particularly perennial legumes, host viruses and their aphid and leafhopper vectors (e.g. Cucumber mosaic virus).

It is not recommended to grow a pulse again after a failed pulse crop because disease pressure is increased, herbicide residues can be limiting, and there is the potential for cross-contamination of seed reducing its market value.[11]

Herbicide interaction

Herbicide residues in soil and crop damage from herbicides are known to increase the risk of disease. This may be by directly damaging the plant making it easier for the disease to enter, or by reducing the overall health of the plant making it more vulnerable to disease.

10 Pulse Australia (2016) Southern faba & broad bean best management practices training course – 2016. Pulse Australia.

11 Pulse Australia (2016) Residual herbicides and weed control. Pulse Australia website, http://pulseaus.com.au/growing-pulses/publications/residual-herbicides

Ensure the maximum plant-back period and rainfall conditions for herbicides are adhered to. Triazine, clopyralid, imidazolinone and sulfonylurea herbicides are known to predispose plants to disease.

When diagnosing damage in the field it can be difficult to determine whether the cause of damage is disease or herbicide or a combination of both.

9.5 Good hygiene

Diseases can carry over on stubble, seed or soil (Table 3).

Table 3: Carryover of major faba bean diseases. The relative importance as sources of infection is indicated by the number of stars with three starts being the most important.

Disease	Stubble	Seed	Soil
Ascochyta blight	★★★	★★	★
Chocolate spot (Botrytis)	★★★	★	★
Cercospora	★★	—	★★★
Rust	★	—	—

Source: Pulse Australia (2016)[12]

Chocolate spot and Ascochyta blight can carry over from one season to the next on infected faba bean seed. Purchase disease-free seed or retain seed from the healthiest crop to avoid carryover on infected seed.

Control volunteer beans, vetch and lentil during the summer–autumn season and in fallows to avoid carryover of inoculum of chocolate spot, Ascochyta blight and rust pathogens. Some broadleaf weeds are alternative hosts of one or more of the viruses that affect beans, and of *Sclerotinia* species, and should be controlled prior to planting and during crop growth.

Burn or bury last year's pulse stubble if erosion is not a risk. Grazing over summer may reduce stubble, but be aware that stock can carry infected stubble between paddocks. Adhere to grazing restrictions on stubble from crops treated with fungicides.

Infected stubble may also be carried by wind, water (particularly flooding) or machinery at harvest.

Where practical, clean all machinery, transport equipment and storage bins thoroughly with compressed air before moving to the next paddock. Spray rigs, should also be cleaned to reduce the risk of disease transmission particularly if contractors are used.

Paddock inspections should be carried out using clothing suitable to the task and footwear should ideally be disinfected prior to entering a crop. This is an important point for agronomists who may move through several crops in one day.

Floodwaters may transport disease agents. Floods during January 2011 would have moved faba bean stubble infested with Ascochyta blight, as well as soil and weeds harbouring the pathogen.

12 Pulse Australia (2016) Southern faba & broad bean best management practices training course – 2016. Pulse Australia.

9.6 Use clean seed

Use only high-quality seed with good purity, germination and vigour.

Seed-borne inoculum is usually less important than stubble-borne inoculum, except for Ascochyta blight, which is carried under the seed coat. It is not the major source of infection for chocolate spot, Cercospora leaf spot and rust, but can be a factor. Infected seed is important in the establishment of diseases in new faba-bean growing regions.

Avoid using seed with greater than 5% Ascochyta blight infection or 10% chocolate spot, and where possible use seed with nil infection. It is more important to avoid seed with disease infection in susceptible varieties. Source seed from a paddock where diseases, particularly those which affect pods, were not detected. Where possible, have seed tested for disease status.

9.6.1 Seed dressings

Fungicide seed dressings are registered for faba and broad bean but not often used (Table 4).

Table 4: Seed dressings registered for use with faba and broad bean.

Active ingredient	**Thiram + thiabendazole**
Example trade name	**P-Pickel® T**
Ascochyta blight	NR
Botrytis grey mould	NR
Damping-off	Registered
Fusarium	Registered
Phoma root rot	NR
Phytopthora root rot	NR
Pythium	Registered
Jurisdiction	All states

Registered = registered product label claim, NR = not registered for use in this crop
Refer to the current product label for complete 'Direction for Use' prior to application.

Prior to the use of any crop protection product, ensure that it is currently registered or that a current permit exists for its use in faba and broad bean.

Source: Pulse Australia (2016) Southern faba & broad bean best management practices training course – 2016. Pulse Australia

Thiabendazole plus thiram (e.g. P-Pickel T®) is registered in faba bean for seedling root rots (*Fusarium* spp. and *Pythium* spp.). It has some efficacy against Ascochyta blight and Botrytis grey mould (BGM). Seed dressings are not effective against viruses and bacterial diseases.

Seed dressings only protect the emerging seedling from seed-borne Ascochyta and Botrytis. They will not protect the emerged seedling from raindrop-splashed Ascochyta or wind-borne Botrytis.

The presence of rhizobium for effective nodulation and healthy plant growth is usually more important than a fungicidal seed treatment. Do not mix rhizobia inoculant with fungicide seed dressings. Apply the fungicide seed dressing first and then apply the inoculants as a second operation sometime later after the fungicide has dried and immediately prior to seeding. Granular inoculant or fluid injection of rhizobia avoids contact between rhizobia and any seed treatment.

13 Pulse Australia (2016) Southern faba & broad bean best management practices training course – 2016. Pulse Australia.

9.7 Sowing

9.7.1 Sowing date

Aim for the optimum sowing window for the pulse variety and your district. The recommended sowing times are in Section 4 Planting.

Avoid sowing too early as early crop emergence may coincide with greater inoculum pressure from old crop residues nearby. Early sowing may also lead to excessive vegetative growth and early canopy closure, providing a more humid environment ideal for infection.

Later sowing reduces disease risk, but can result in lower yields due to the risk of dry conditions and high temperatures at flowering to pod-fill. Yield can be reduced by 150–250 kg/ha for every week past the optimum sowing time.

9.7.2 Sowing rate and row spacing

Higher plant populations can exacerbate foliar disease development by encouraging a dense canopy and a more humid environment.

Reduced humidity can be achieved by reducing the sowing rate, increasing the row spacing and by achieving good weed control. Avoid sowing headlands.

Optimum plant populations for most faba beans (e.g. 50–70 g/100 seeds) can range from 20–35 plants/m^2.

For the medium to larger sized faba beans and for small broad bean seed (e.g. 85–110 g/100 seeds), optimum plant populations can vary from 15–25 plants/m^2.

For larger broad bean seed (e.g. 110–160 g/100 seeds), optimum plant populations can vary from 8–12 plants/m^2.

Seeding rates resulting in lower than recommended plant populations can reduce disease but can also reduce potential crop yield.

If seed with possible disease infection needs to be used sow deeper than normal to help reduce the emergence of infected seedlings. The seeding rate must be adjusted upwards to account for the potential of a lower emergence and establishment percentage.

Generally, faba bean row spacing varies from 15 to 30 cm, but up to 55 cm with broad bean. Wide row spacings (25–60 cm) can assist with the control of chocolate spot by delaying canopy closure and reducing the humidity between rows.

Some growers are now using row spacing of 75–100 cm, or using paired rows, to improve pod-set, delay canopy closure and hopefully minimise disease. Wide rows allow herbicides to be sprayed between rows with hooded shields or targeted row spraying with fungicides to reduce the amount of product applied. However, wide rows can also lead to crop lodging, which can exacerbate disease in the later stages.

To avoid potential ‘hot spots’ for disease, consider ‘tram-lining’ and controlled traffic. Physical damage to the crop from machinery travelling over the paddock can be a major cause of disease outbreaks.

Some growers believe that sowing in wide rows in a north–south direction improves pod-set and disease control.

9.8 Risk assessment

Risk assessment is about assessing the known risks (e.g. paddock history), deciding what can be changed and weighing these up against the unknowns (e.g. seasonal conditions).[14] While the overall aim is to reduce the level of risk each grower will have a different level of tolerance to risk.

There are three steps in risk assessment.

1. Identify factors that determine risk

Pathogen: Exotic *v.* endemic; biotypes, pathogenicity, survival and transmission, amenable to chemical management.

Host: Host range; varietal reactions, vulnerability, does susceptibility change with growth stage?

Environment: Weather dependency, interactions with nutrition, herbicides, other diseases, agronomic factors, e.g. planting depth, row spacing, no-tillage, soil conditions.

Risk management: Access to components of management plan; ease of implementing plan; how many options; cost of implementation.

2. Assess level of factors

Pathogen: Level of inoculum, dirty seed, aggressiveness of isolate, weed hosts prevalent in paddock or nearby, paddock history.

Host: How susceptible, nutritional status, frost susceptibility, herbicide susceptibility.

Environment: Length of season; likelihood of rain, drought, waterlogging, irrigation; availability of spray gear; paddock characteristics, herbicide history.

Risk management: Has it not yet been considered; a plan is being developed; or is a plan in place?

3. What risk level is acceptable?

High: Grower is prepared to accept substantial yield loss as potential returns are high and financial situation sound; crop failure will not impact on rotation or other components of the farming system.

Low: Grower needs cash flow and cannot afford to spend much or lose the crop; failure impacts seriously on farming system.

9.9 Symptom sorter

This symptom sorter (Table 5) can be used to help diagnose diseases from other crop damage causes starting from the symptom description.

14 Pulse Australia (2016) Southern faba & broad bean best management practices training course – 2016. Pulse Australia.

FEEDBACK

Table 5: Faba bean symptom sorter.

Description	Crop effect	Plant symptoms	Disorder
Scattered plants	Wilting	Premature death	Sclerotinia rot
	Yellow/pale green	Leaves distorted	Mosaic viruses
	Stunted	Premature death	Yellowing viruses
Patches	Poor emergence	Plants chewed	Mouse damage
			Snails
	Brown/grey	Stem & leaf spotting	Redlegged earth mite
			Chocolate spot
	Yellow/red	Stunted	Root rots
			Dodder
		Premature death	Root & crown rot
	Pale green	Leaf & pod spotting	Thrips
	Stunted	Leaves/stem distorted	Stem nematode
			Mites (seedlings)
	Wilting	Leaves distorted	Cow pea aphids
	Physically damaged	Stems, leaves & pods	Mouse damage
			Bird/ hare damage
Highly alkaline soil	Yellowing	Young leaves yellow	Iron deficiency
		Tip death	Manganese deficiency
	Patches	Plants chewed	Snails
	Stunted	Black leaf edges	Group B herbicide damage
Acidic soil	Yellow/red	Stunted	Nodulation failure
Low-lying areas	Grey	Black leaf edges	Frost
	Yellow/red	Premature death	Waterlogging
General	Poor emergence	Stunted	Seed sown too deep
		Tip death	Triazine herbicide
	Stunted	Young leaves yellow	Group F herbicide damage
		Leaf spotting	Zinc deficiency
		Leaves distorted	Clopyralid herbicide damage
	Pale green	Leaves distorted	Group M damage
			Group I herbicide damage
		Leaf spotting	Downy mildew
	Yellow/red	Tip death	Boron toxicity
	Grey/brown	Leaf spotting	Ascochyta blight
			Chocolate spot
			Rust
			Cercospera
			Alternaria
			Hail
	Physically damaged	Leaf, stem & pods damaged	Triazine herbicide
	None obvious	Pods chewed	Native budworm
		Pod spotting	Oedemas

Source: Faba beans: The Ute Guide (2009) Yeatman *et al*[15]

15 T Yeatman, W Hawthorne, J Paull, J Bellati, J Egan, K Henry, R Kimber, M Seymour, J van Leur, K Lindbeck, P Matthews, I Rose (2009) Faba Beans: The Ute Guide. Primary Industries and Resources South Australia, https://grdc.com.au/resources-and-publications/all-publications/publications/2009/11/faba-beans-the-ute-guide/

9.10 Crop monitoring

The four main diseases where monitoring is necessary are chocolate spot, Ascochyta blight, Cercospora leaf spot and rust.[16] Monitoring for these diseases also provides the opportunity to look for other diseases, weeds or plant disorders. To be effective, crop monitoring needs to include a range of locations in the paddock, preferably following a 'V' or 'W' pattern.

9.10.1 Ascochyta blight

The initial symptoms will be lesions on the leaves and stems of young plants. A distinguishing feature is fungal fruiting structures (small black dots) visible within the centre of lesions.

Monitoring should commence 2–3 weeks after emergence, or 10–14 days after a rain event. This allows time for disease expression after an infection event, such as transmission from infected seed or rain-splashed inoculum. Note that infected seedlings may deteriorate quickly and plant-parts above the lesion may also break-off making symptoms difficult to detect.

Timing is critical. After the initial inspection, subsequent inspections should occur every 10–14 days after a rain or heavy dew event. During dry periods, inspections can be less frequent. When monitoring, look for signs of lesions on leaves, or if severe, wilting in upper foliage or small areas of dead or dying plants, and if present examine individual affected plants for symptoms of infection. This method will allow more of the crop to be inspected than a plant-by-plant check.

9.10.2 Chocolate spot

Chocolate spot may be found at low levels in the middle of the season. It can gradually spread up the canopy and will be ready to progress rapidly when temperatures rise and leaf moisture conditions are favourable. Look for lesions low in the canopy when inspecting for Aschochyta or Cercospora.

Chocolate spot is more likely to occur in bulky crops where there is canopy closure. The critical stage for management will be just before the commencement of flowering, as temperatures begin to increase, and then regularly through the flowering and seed filling period. Lesions occur on leaves and flowers first, but can occur on stems and pods. Flower abortion and drop can occur. Protection of flowers is an important component of a fungicide strategy.

Symptoms first appear as small brown spots on leaves and flowers that rapidly develop into large, irregular-shaped lesions on leaves and decay of flowers when conditions remain favourable.

Chocolate spot requires high leaf moisture or humidity (>70%) within the crop canopy and optimal temperatures of 15°C–28°C. When humidity levels decrease or maximum daily temperatures exceed approximately 28°C, the infection levels decline sharply.

More regular crop monitoring and protection may also be required if high-risk situations exist such as:

- immediately adjacent to last year's crop;
- non-optimal paddock selection (e.g. waterlogging);
- high disease pressure experienced last year;
- a susceptible variety is planted; and
- shortened rotation.

16 Pulse Australia (2016) Southern faba & broad bean best management practices training course – 2016. Pulse Australia.

9.10.3 Cercospora leaf spot

Cercospora leaf spot monitoring must start 2–3 weeks after emergence, or within 4–6 weeks from sowing, when seedlings are small. This is particularly so where faba beans have been grown in the paddock in recent years or there have been many bean crops grown in that paddock over time.

Protective fungicide needs to be applied before or at first signs of Cercospora leaf spot lesions, or within the monitoring timeline irrespective of symptoms when disease risk is high.

Subsequent monitoring should occur when checking for chocolate spot prior to and during flowering and podding.

9.10.4 Rust

In the southern region rust is more commonly observed later in the season when temperatures are 20°C–30°C and conditions are humid. However, it can occur earlier. The time to start monitoring for rust in southern Australia depends on sowing time and presence of infection on bean stubbles from the previous year.

With early-sown beans, infection may occur at early emergence when temperature and rainfall conditions are suitable for its spread. Later-sown beans may not get infected until spring time when temperatures, moisture conditions and humidity are high.

Monitor for rust 2–3 weeks after emergence, or 4 or 5 weeks after sowing, usually when monitoring for Cercospora leaf spot or Ascochyta blight. Protect early-sown beans against early infection when Cercospora leaf spot is also being controlled with foliar fungicide.

Also monitor for rust when monitoring for chocolate spot and late Ascochyta blight.

FEEDBACK

MORE INFORMATION

More information about free information services is available on eXtensionAUS, http://extensionaus.com.au/field-crop-diseases/pathology-electronic-newsletters/.

IN FOCUS

9.11 Free alert services for diseases

Growers can subscribe to newsletters that provide local pest updates. The services listed below are all free.

South Australian Research and Development Institute (SARDI)

- Crop Watch disease newsletter by email. Subscribe by emailing DK Communications (dvkam@iprimus.com.au)
- Follow the Crop Watch Twitter account @CropWatchSA

Agriculture Victoria

- Crop Alert disease update by email. Subscribe by emailing crop.safe@ecodev.vic.gov.au
- General grains information is available on the Twitter @VicGovGrains

Southern NSW and northern Victoria

- NSW DPI and GRDC provide the Crop Disease Bulletin for advisers in southern NSW and northern Victoria. To subscribe contact Kurt Lindbeck (kurt.lindbeck@dpi.nsw.gov.au) or Andrew Milgate (andrew.milgate@dpi.nsw.gov.au).

Australia-wide

- GrowNotes™ Alert on the latest weed, pest and disease issues in your area delivered via App, SMS, voice, email, social media or web portal (or a combination of preferred methods). Subscribe to this GRDC and Agriculture Victoria service on the GRDC website.
- For disease issues across Australia follow eXtensionAus on Twitter @AusCropDiseases or Facebook (https://www.facebook.com/AusCropDiseases/)

FEEDBACK

MORE INFORMATION

For details on permits and registrations visit:

https://portal.apvma.gov.au/permits

https://portal.apvma.gov.au/pubcris

9.12 Using fungicides

The legal considerations for using fungicides are the same as for herbicides (see Section 7.7 Using herbicides).

9.12.1 Registered products

Managing foliar disease in faba bean is all about reducing the risk of infection. Fungicides are preventative and need to be sprayed before disease is evident.[17] Fungicides protect against new infection, but do not cure existing infection. Getting the timing right is critical.

Unprotected crops can lose over 50% in yield and in severe cases the crop may drop all of its leaves. Monitoring for early detection and correct disease identification is essential.

Controlling disease with fungicides depends on:

- the timeliness of spraying;
- the weather conditions that follow; and
- the susceptibility of the variety grown.

Disease-resistant varieties require a much less intensive foliar fungicide program than susceptible varieties.

Fungicides last around 2–3 weeks. Any new growth after fungicide is applied is not protected. In periods of rapid growth and intense rain (50 mm over several days) the protection period will reduce to 7–14 days.

The need and timing of repeat fungicide sprays depends on:

- the amount of unprotected growth;
- rainfall since spraying; and
- the likelihood of a further extended rainy period.

Plan ahead to ensure that fungicides can be applied as soon as a decision is made.[18] Do not compromise a fungicide spray to wait until it can be combined with herbicide application. Ideally, spray 1–2 days before significant rain is forecast. Don't delay if rain has already started. A light rain of less than 12 mm can increase the efficacy of mancozeb.

Good leaf coverage with lots of fine droplets will maximise the benefit. Use high water rates. For ground application use 100 L water/ha, unless a different minimum rate is specified on the label. For air application use 30 L/ha. Spray early in the morning when dew is present to assist fungicide spread.

The registered fungicides are mancozeb, carbendazim, chlorothalonil, copper, metiram, procymidone.[19] Tebuconazole is available under permit (PER13752). Check pesticide permits and registrations for any changes in use patterns before using fungicides. Selecting the right fungicide for the specific disease being targeted is important.

Check the efficacy of each fungicide against each disease (Table 6). Some products are broad-spectrum and are effective against more than one disease (such as products containing carbendazim, mancozeb and chlorothalonil), while others are specific against single diseases (such as products containing procymidone).

Mancozeb, chlorothalonil, metiram and copper are protectants and have no curative action on existing infections. Newly grown, untreated foliage will not be protected.

17 NSW DPI 2002 Foliar diseases of faba beans: management in southern NSW. Pulse point 16, NSW Department of Primary Industries, http://archive.dpi.nsw.gov.au/__data/assets/pdf_file/0017/157400/pulse-point-16.pdf

18 P Matthews, D McCaffery, L Jenkins (2016) Winter crop variety sowing guide 2016, NSW DPI Management Guide. NSW Department of Primary Industries, http://www.dpi.nsw.gov.au/agriculture/broadacre/guides/winter-crop-variety-sowing-guide

19 P Matthews, D McCaffery, L Jenkins (2016) Winter crop variety sowing guide 2016, NSW DPI Management Guide. NSW Department of Primary Industries, http://www.dpi.nsw.gov.au/agriculture/broadacre/guides/winter-crop-variety-sowing-guide

Carbendazim and procymidone have protectant and limited curative action and work best when applied before an infection event. These fungicides are not translocated from sprayed leaves so foliage that grows after spraying is not protected.

Label regulations limit carbendazim to a maximum of 2 consecutive sprays at 14 day intervals. Carbendazim is a systemic fungicide with single-site specificity so the probability of resistance developing increases with regular use. It is best to alternate carbendazim with either chlorothalonil or mancozeb. Observe the withholding period for grain prior to harvest for carbendazim (4 weeks).

Table 6: Foliar fungicides for the control of foliar diseases in faba and broad bean.

Active ingredient	Carbendazim	Procymidone	Chlorothalonil	Mancozeb	Tebuconazole	Copper
Example trade name	**Spin Flo®**	**Sumisclex®**	**Barrack®/ Unite® #**	**Dithane® Rainshield**	**Folicur®**	**Blue Shield®**
Ascochyta blight	-	-	E	R	-	-
Chocolate spot	R	R*	R	R	-	R
Cercospora leaf spot	E			R	P*	
Rust	-		R	R	P*	R
Jurisdiction	All states	Most states	All states	All states	Most states	All states

R = Registered product label claim P = permit E = has efficacy on this disease but is not registered for its control in this crop
* = not registered all states

These are the only registered chlorothalonil products that allow grazing of bean stubble and are registered in other pulses.

Refer to the current product label for complete 'Directions for Use' prior to application.

Prior to the use of any crop protection product, ensure that it is currently registered or that a current permit exists for its use in faba bean or broad bean.

Source: Southern faba & broad bean best management practices training course, (2016), Pulse Australia

The first fungicide spray must be applied as early as necessary to minimise the spread of the disease (Table 7). Additional sprays are required if the weather conditions favour the disease.

Table 7: When to spray for fungal disease control in faba bean.

Disease	Occurrence	When to spray
Ascochyta blight	First appears in cool and wet conditions before flowering	At 6–8 weeks after sowing, during seedling stage. Again during flowering if Ascochyta blight is detected and rain is likely. Again at end of flowering when pods are filling, if Ascochyta blight is detected and rain is likely. Disease is spread by rainfall.
Chocolate spot	Develops late winter (15°C–20°C) in humid (>70%) conditions, usually at flowering	During early to mid-flowering as a protective spray. An earlier spray may be required if lesions are observed prior to flowering. Additional sprays may be necessary through flowering and pod-filling if disease progresses. Disease is favoured by warm weather (15°C–20°C) and high humidity (>70% RH).
Cercospora leaf spot	On lowest leaves soon after emergence	Shortly after emergence prior to establishment of disease. Approximately 5–7 weeks after sowing
Rust	Later in the season, during warm (20°C–30°C) humid conditions.	At first sign of disease during flowering or pod-filling. Disease is favoured by warm (20°C–30°C) and humid conditions.

Source: Southern faba & broad bean best management practices training course (2016). Pulse Australia

FEEDBACK

MORE INFORMATION

Pulse Australia has information on crop protection products and minor use permits, please see http://www.pulseaus.com.au/growing-pulses/crop-protection-products

9.12.2 Current minor use permits (MUP)

Some products may be available under permit, with conditions attached, until enough data is generated for full registration. In other cases, a temporary permit may be granted when there is a particular seasonal issue.

Pulse Australia holds several minor use permits (MUPs) on behalf of the pulse industry and is actively involved in the pursuit of new permits and label registrations to meet industry needs.[20]

The current minor use permit for fungicides is:

- **PER13752**
  Tebuconazole for use in faba and broad bean to control Cercospora leaf spot and rust.
  Current to 30 June 2019.

Tebuconazole can be applied early in the crop cycle for Cercospora leaf spot or later in the season to control both Cercospora leaf spot and rust.[21] Apply at the first sign of disease or when conditions favour disease development. Apply a maximum of 3 times per season, 14–21 days apart.

9.12.3 The critical periods for fungicide use

Monitor crops at least once a week during all critical periods. Be prepared to spray when rain is forecast. Visible lesions will only appear several days after wet conditions.

Fungicide application during critical periods is a standard practice in high rainfall regions, irrigation districts, in a wet year or in high disease risk situations. A crop is at high risk if susceptible varieties are grown, crop rotation is short, sown adjacent to faba bean stubble, infected seed is sown or where all preventative management strategies cannot be followed.

The timing based on the resistance status of varieties is detailed in Figure 3.

20 Pulse Australia (2016) Crop protection products. Pulse Australia website, http://pulseaus.com.au/growing-pulses/crop-protection-products

21 C Benjamin (2013) New faba bean rust option. GRDC GroundCover™, Issue 106, September–October 2013, https://grdc.com.au/resources-and-publications/groundcover/ground-cover-issue-106-sept-oct-2013/new-faba-bean-rust-option

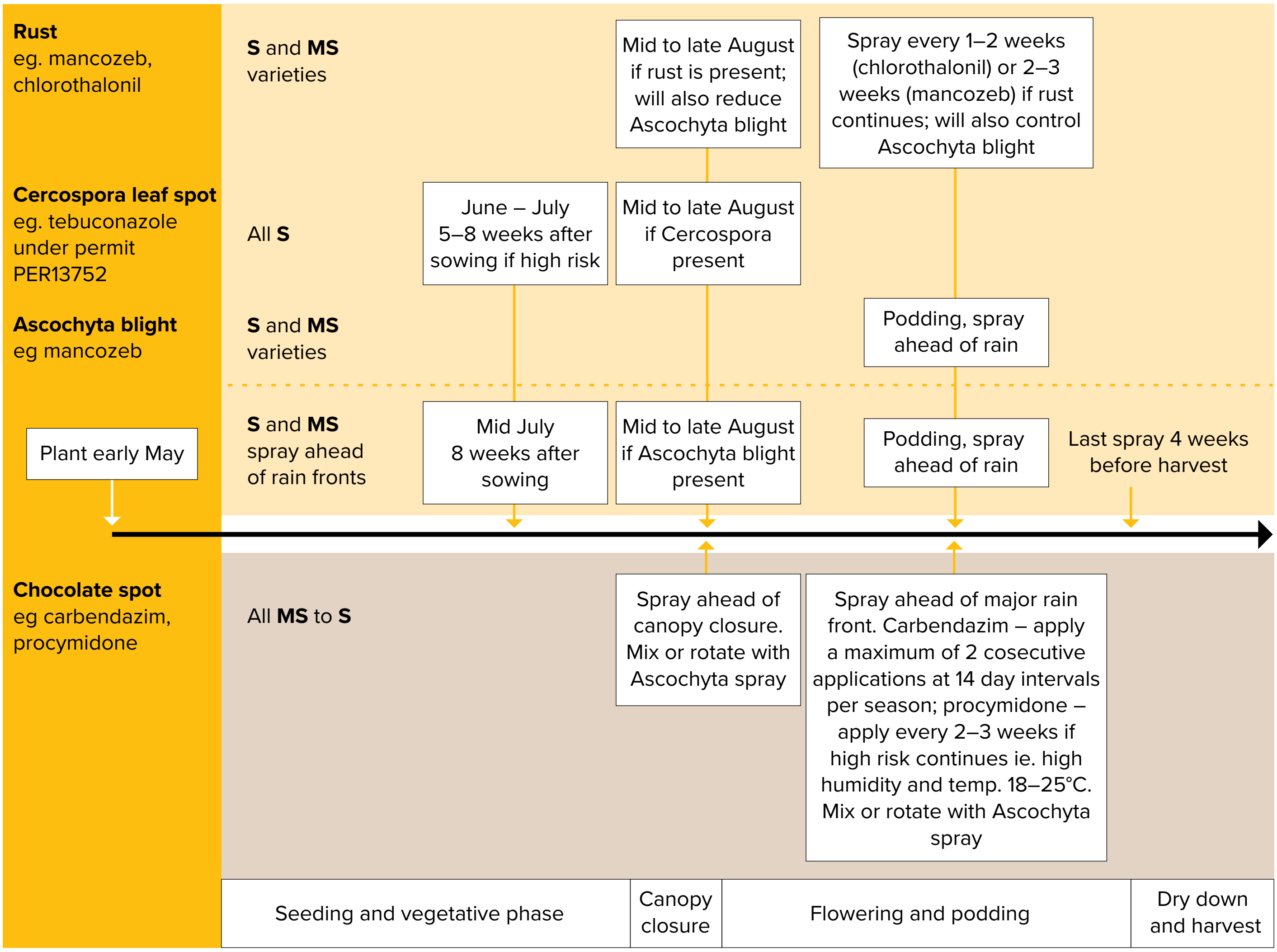


Figure 3: *Fungicide timing for faba bean disease control. The specific times are based on variety Resistance (R) or Susceptibility (S) to that specific disease.*

Source: Jenny Davidson, SARDI

First critical period

This is 5–8 weeks following emergence.

The main target is Ascochyta blight in susceptible varieties to limit the early establishment of the disease. For Ascochyta blight, mancozeb is recommended to be applied regardless of whether symptoms are visible. Cercospora leaf spot should also be targeted at this stage and is most effectively controlled in this period with tebuconazole.

Second critical period

This is during early flowering just prior to canopy closure, 13–16 weeks after emergence.

This is the last opportunity to protect against disease prior to canopy closure. It is the critical period when the fungicide can penetrate deep into the canopy to protect lower leaves at a time when disease can impact on yield by causing leaf lesions, flower drop and pod abortion.

Chocolate spot is most devastating at flowering and pod-set. A protective foliar fungicide application at early to mid-flowering, before symptoms appear is vital to prevent it becoming established under the crop canopy. If symptoms were observed and managed earlier this pre-canopy closure spray is still important. Varieties susceptible to Ascochyta blight will require a fungicide application at this time to prevent further spread of the disease. A fungicide to target Cercospora leaf spot may be required if early control was inadequate.

If the crop has good yield potential apply fungicide when:

- rain events are likely;
- canopy closure is about to occur;
- chocolate spot is present; or
- Ascochyta blight is present and the variety is susceptible.

Fungicide mixtures may be required to target multiple diseases. More than one spray may be required when disease pressure is high.

Third critical period

This is at the end of flowering and early pod-fill, 15–20 weeks after emergence.

Apply fungicide to protect developing pods, preventing any further disease spread. Target Ascochyta blight, chocolate spot and rust.

Chocolate spot must be controlled when conditions are favourable for this disease. It may be necessary to control rust if it has become established as epidemics can form rapidly.

Control Ascochyta blight in susceptible varieties to limit seed staining when wet weather persists up to harvest. Fungicide can be applied until just prior to drying down provided withholding periods are adhered to.

Apply fungicide if the crop has sufficient yield potential and when:

- rain is forecast; or
- significant growth has occurred since previous fungicide application.

Fungicide mixtures may be required to target multiple diseases. More than one spray may be required when disease pressure is high.

MORE INFORMATION

NVT Crop Disease AU app for android and iOS, http://www.nvtonline.com.au/interactive-tools/apps/

SARDI has information on:
Seed and crop testing
http://pir.sa.gov.au/research/services/crop_diagnostics/seed_and_crop_testing

and PreDicta B® testing
http://pir.sa.gov.au/research/services/molecular_diagnostics/predicta_b

AgVic has information on CropSafe
http://agriculture.vic.gov.au/agriculture/grains-and-other-crops/grain-and-crop-health/cropsafe-program

and seed health testing in pulse crops http://agriculture.vic.gov.au/agriculture/pests-diseases-and-weeds/plant-diseases/grains-pulses-and-cereals/seed-health-testing-in-pulse-crops

DPIPWE has information on plant pathology http://dpipwe.tas.gov.au/biosecurity-tasmania/plant-biosecurity/plant-health-laboratories/plant-pathology-laboratory

NSW DPI has information on plant health diagnostic services
http://www.dpi.nsw.gov.au/about-us/services/laboratory-services/plant-health The eXtensionAUS webpage has details on disease testing services around Australia http://extensionaus.com.au/field-crop-diseases/disease-testing-services-around-australia/

9.13 Correctly identifying diseases

Correct disease identification is important as this will determine the choice of product.

Symptoms of Ascochyta and chocolate spot, the most damaging diseases, can be confused with symptoms of Cercospora leaf spot. In addition, symptoms may be similar to damage on leaves from herbicides or physical events, which then allow minor diseases such as Alternaria (*Alternaria alternata*) to infect the plant tissue. Correct disease identification is necessary to avoid unnecessary spraying or incorrect fungicide use.

9.13.1 Diagnostic skills

Accurate diagnosis is essential to effectively manage disease. An incorrect diagnosis can be more costly than inaction.[22]

Not all plant disorders are cause by plant pathogens; consider genetic, insect, animal, environmental and agronomic causes.

Some problems involve more than one cause, although usually there will be only one major cause.

Looking at the problem in the paddock is more likely to lead to a correct diagnosis than examining specimens in the office.

Take notes and photographs. As well as recording historical information (e.g. sowing date, variety, previous crop etc), describing the distribution and symptoms in writing forces us to see what we're looking at. Include this information when sending a sample away for diagnosis.

Follow these steps for an accurate diagnosis:

What is the distribution of the disorder across the district?

- Regional distribution of a problem can eliminate many causes and may identify likely ones.
- If only one crop or one grower in the district has the problem, the cause is unlikely to be environmental (but it could be lightning), or an air-borne disease e.g. faba bean rust.
- Isolated problems often reflect some agronomic problem e.g. wrong type or rate of herbicide, poor quality seed, inadequate nutrition, nodulation failure, deep seeding or a soil-borne pest or disease.

What is the distribution of the disorder across the paddock? Is the pattern linked with a farming operation (past and present)?

- For example, cultivation, old fence line, sheep camp, sowing, varieties, spraying, harvesting?
- Does it follow drainage lines or is it confined to low or high parts of the paddock?
- Does it affect individual plants throughout the paddock; individual plants at the edge of the crop or in thin areas.
- Does it occur in patches?

Walk through the crop with your eyes shut sensing changes in soil compaction to establish links between hard zones and symptoms.

- Run your hands across the plants – do they feel stiff and leathery; cool or hot?

What's the weather been like?

- Could it be frost, heat stress, drought, waterlogging?

What's the insect activity been like?

- Aphids on the windscreen, moths in the crop.

22 Pulse Australia (2016) Southern faba & broad bean best management practices training course – 2016. Pulse Australia.

Determine the progression of symptoms. Look at plants showing the range of symptoms from apparently healthy to just starting to show the problem to just about the die.

- Are plants easy to pull up?
- Do they break off at ground level?
- Look for evidence of feeding by insects, birds or rodents.

Dig up plants:

- Is soil clinging loosely to their roots (evidence of fungal hyphae)?
- Wash soil from roots in bucket and examine against a light-coloured background.
- Make progressive tangential slices into the root, collar and stem looking for vascular discolouration.

Finally, if you suspect a plant disease, remember the Disease Triangle (Figure 1). A crop can only have a serious disease problem if three conditions are met:

- susceptible host;
- prevalent causal agent; and
- favourable environment.

9.13.2 Sending samples for disease diagnosis

For accurate diagnosis it is imperative that specimens are carefully selected, well presented and submitted with adequate information.[23]

Selection of specimens

Select plants that show the range of symptoms from slightly to severely affected. Include several healthy plants for comparison. Collect whole plants if practicable, including the roots. For root diseases, include roots and some soil from the root zone (i.e. roots contained in a soil plug).

Preservation

Fresh plant specimens are preferred. If delays in transit are likely and plant material is likely to break down and/or become mouldy, dry specimens are recommended.

DO NOT FREEZE samples.

Fresh specimens are best stored in aerated conditions at high humidity and cool temperatures, preferably not on the back seat of a ute in the sun. Use an esky with fridge bricks to keep samples cool. Diagnosis of viruses requires very fresh specimens. Plants should be wrapped in dry paper and placed in a plastic bag. The paper should not be wet. If dead tissue is present on the sample, damp paper should be avoided as moulds may develop.

Dried specimens are best when dried rapidly, but again not in the back of the ute. Place plant parts between sheets of newspaper (with some pressure), and change paper daily for 1 week.

Packaging

Fresh specimens: specimens likely to decompose e.g. pods should be wrapped in paper and placed in a suitable container. Other plant parts can be placed in partially inflated plastic bags and tied-off (fairly loosely to allow aeration but not desiccation). Soil samples should be packed in a sealed plastic bag or airtight container.

Dry specimens: should be supported between 2 firm surfaces e.g. cardboard, before dispatch.

Note that diagnoses for suspect virus diseases can only be made with fresh specimens.

23 QDAF (2016) How to collect, prepare and package samples for analysis. Queensland Department of Agriculture and Fisheries, https://www.daf.qld.gov.au/plants/health-pests-diseases/plant-pest-diagnostic-services/grow-help/collecting-samples

Labelling

Use waterproof ink. All containers should be clearly marked. If labels are placed inside bags use plastic as paper can become mush.

Dispatch

Specimens should be sent ASAP after collection. Send early in the week to avoid delays over the weekend. Label the item ‘Plant Specimens – Perishable’ or ‘Soil Samples’.

Before sending check whether the relevant authority has a submission form.

The information usually required includes:

- Name and address of grower and location of crop
- Host and variety (if not obvious)
- Area of injury e.g. leaves, roots, pods
- Nature of injury e.g. leaf scorch, root rot, leaf spot
- Prevalence/distribution e.g. localised, entire field, scattered
- Severity
- Soil type, moisture and drainage
- Previous cropping history
- Other useful details such as chemical usage, fertiliser applications, irrigations, growing conditions, frost, weather conditions.

Relevant contacts

South Australia

SARDI Plant Diagnostic Centre
Ph: (08) 8303 9400

Seed and crop testing:
http://pir.sa.gov.au/research/services/crop_diagnostics/seed_and_crop_testing

Post to:
Locked Bag 100,
Glen Osmond, SA, 5064

Courier to:
Plant Research Centre, Waite Institute
Gate 2B, Hartley Grove,
Urrbrae, SA 5064

South Australia

SARDI Molecular Diagnostics Group
Ph: (08) 8303 9400

PreDicta® B nematode testing:
http://pir.sa.gov.au/research/services/molecular_diagnostics/predicta_b

Post to:
C/- SARDI RDTS
Locked Bag 100,
Glen Osmond, SA, 5064

Courier to:
SARDI Molecular Diagnostics Group
Plant Research Centre
Gate 2B
Hartley Grove
Urrbrae SA 5064

Victoria

DEDJTR Pulse Pathology,
Ph: (03) 5362 2111

Post to:
Private Bag, Natimuk Rd,
Horsham, VIC 3401

Courier to:
110 Natimuk Rd
Horsham, VIC 3401

Victorian samples may also be submitted via agronomists through the Cropsafe program. The program aims to provide the early detection of exotic diseases.
http://agriculture.vic.gov.au/agriculture/grains-and-other-crops/grain-and-crop-health/cropsafe-program

Tasmania

Ph: 1300 368 550
Email: Biosecurity.planthealth@dpipwe.tas.gov.au

Prices:
http://dpipwe.tas.gov.au/biosecurity-tasmania/plant-biosecurity/plant-health-laboratories/plant-pathology-laboratory

New South Wales

Prices and submission forms:
http://www.dpi.nsw.gov.au/about-us/services/laboratory-services/plant-health

Plant Health Diagnostic Service
– Wagga Wagga
Ph: (02) 6938 1608

Post to:
Wagga Wagga Agricultural Institute,
Private Bag, Pine Gully Road,
Wagga Wagga, NSW 2650

Plant Health Diagnostic Service
– Tamworth
Ph: (02) 6763 1133

Post to:
Tamworth Agricultural Institute,
RMB 944, 4 Marsden Park Rd,
Calala, NSW 2340

FEEDBACK

MORE INFORMATION

The CropPro webpage has information on Ascochyta blight of faba bean, please see http://www.croppro.com.au/crop_disease_manual/ch06s03.php

9.14 Ascochyta blight (AB) (*Ascochyta fabae*)

9.14.1 Symptoms

Lesions can form on leaves, stems and pods of infected plants. Small, circular, dark brown spots first appear on both sides of the leaves unlike chocolate spot, which is initially only on one side.[24] These enlarge and turn light to dark grey in colour becoming irregular in shape, often zonate and may coalesce to cover most of the leaf surface. Leaf tissue next to the lesions may become black and necrotic.

If conditions are moist numerous pycnidia (pinhead-sized black fruiting bodies) develop within the lesions and are often concentrically arranged.

On the stem, lesions are more elongated, sunken and darker than leaf lesions and are usually covered with scattered pycnidia. Stems may split and break at the point of infection causing plants to lodge.

On pods, lesions are sunken, with pale centres and dark margins and may be covered by numerous pycnidia. Well-developed lesions may penetrate the pod and infect developing seeds causing them to be shrunken and discoloured. Badly infected seeds have yellowish-brown stains on the outer seed coat.

Symptoms of Ascochyta blight may be confused with symptoms of Cercospora leaf spot or damage on leaves from herbicides or physical events, which then allow minor diseases such as Alternaria to infect. Correct disease identification is necessary to avoid unnecessary spraying or incorrect fungicide use.

Photo 1: *Typical Ascochyta blight lesion. Infections start as small grey spots and may spread to the leaf edge following moisture run.*

Photo: SARDI via Pulse Australia (2016) Southern faba & broad bean best management practices training course

24 G Hollaway, F Henry, M McLean, P Kant, H Li, S Marcroft, M Rodda, M Aftab, P Trebicki, J Fanning, A Van de Wouw, H Richardson, L Hamilton (2015) Diseases in pulses: faba bean. In Identification and Management of Field Crop Diseases in Victoria, Department of Economic Development, Jobs, Transport and Resources, CropPro website, http://www.croppro.com.au/crop_disease_manual/ch06.php

Photo 2: *Older infections turn pale with black specks.*

Photo: Grain Legume Handbook, (2008), https://grdc.com.au/grainlegumehandbook

Photo 3: *Herbicide damage. Spotting from herbicide application can look like Ascochyta blight or Cercospora leaf spot, but note absence of pycnidia.*

Photo: SARDI via Pulse Australia (2016) Southern faba & broad bean best management practices training course

Photo 4: *Stem infections are sunken with pale centres.*

Photo: Grain Legume Handbook, (2008), https://grdc.com.au/grainlegumehandbook

Photo 5: *Ascochyta blight pod lesions affect seed quality. They range from small isolated spots to the large multiple infections shown here.*

Photo: Agriculture Victoria via Pulse Australia (2016) Southern faba & broad bean best management practices training course

Photo 6: *Damage to stem and grain. (Left) Ascochyta blight on bean stems causes stem breakage and lodging and (right) staining resulting from Ascochyta blight infection. The disease is transferred by seed to new crop.*

Photo: Grain Legume Handbook (2008), https://grdc.com.au/grainlegumehandbook

9.14.2 Economic importance

Ascochyta blight is a widespread and important disease in southern Australia. A 2012 GRDC survey estimated the incidence of Ascochyta blight is 77% of years and 76% of bean crops in the southern region.[25]

Severity varies considerably from crop to crop and between seasons. When seasons are favourable for the disease yield losses range from 10–30% in protected crops. Susceptible varieties can suffer significant yield losses and poor seed quality with losses of up to 80% are possible in unprotected crops (see Section 3.10 Seed quality). Discoloured grains may be rejected or discounted in markets.

A change in Ascochyta blight virulence was observed in 2013 with the new pathotype 2 particularly virulent on PBA Rana⁽ᶦ⁾ and Farah⁽ᶦ⁾.[26] Isolates collected from the field

25 GM Murray, JP Brennan (2012) The current and potential costs from diseases of pulse crops in Australia. GRDC Report, https://grdc.com.au/resources-and-publications/all-publications/publications/2012/06/the-current-and-potential-costs-from-diseases-of-pulse-crops-in-australia

26 J Davidson, R Kimber, C Walela, L McMurray, K Hobson, J Brand and JPaull (2016) Pulse diseases in 2015. GRDC Updates Paper, 9 February 2016, https://grdc.com.au/resources-and-publications/grdc-update-papers/tab-content/grdc-update-papers/2016/02/pulse-diseases-in-2015

have found that pathotype 2 is currently mainly found in the Mid North region of SA, but has also spread to Victoria and the South East of SA. Testing of older isolates show that it was present in the Mid North in 2012, a year before changes were observed in the field. Pathotype 1 is widely distributed in the southern region.

Breeding material has been screened against pathotype 2 and while 73 accessions are resistant to pathotype 1, only 24 were also resistant to pathotype 2. This material will be used in future breeding programs.

9.14.3 Disease cycle

The Ascochyta fungus can survive on crop debris, self-sown plants and on infected seed. The disease spreads short distances from infected to healthy plants by rain-splash spores during the growing season, or over longer distances via wind early in the season.

Infection can occur at any stage of plant growth following rain or heavy dew. Ascochyta infection is likely to occur in environments with prolonged wet, cool (5°C–15°C) conditions and usually develops early in the growing season. Early infection results in the development of leaf lesions. In susceptible varieties these can spread and develop into stem lesions causing crop lodging.

After the commencement of flowering the disease can spread onto developing pods and cause seed staining.

The disease cycle is shown in Figure 4.

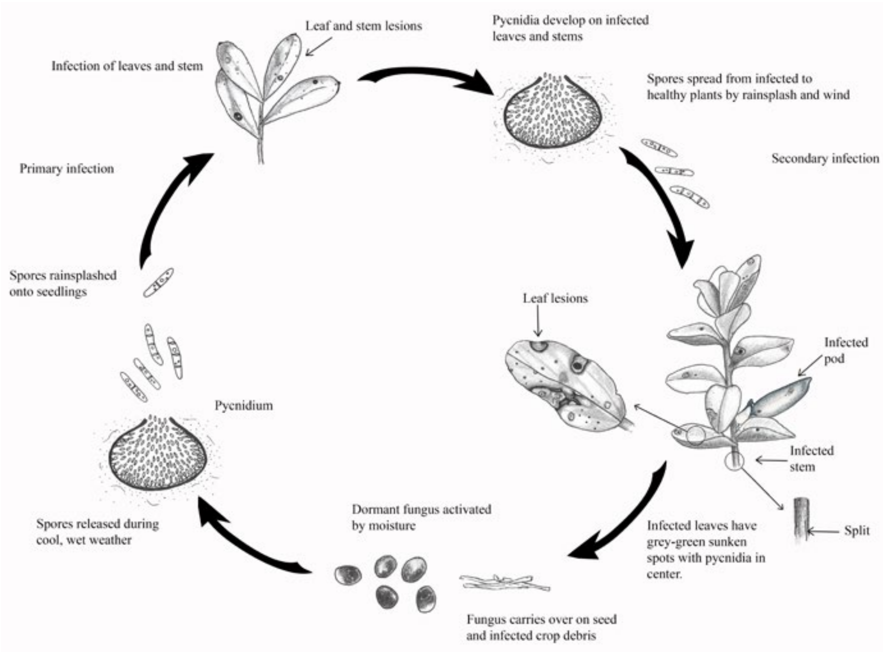


Figure 4: *Disease cycle of Ascochyta blight on faba bean.*

Illustration by Kylie Fowler. Source: Hollaway *et al* (2015), Diseases in pulses: faba bean. In Identification and Management of Field Crop Diseases in Victoria. Department of Economic Development, Jobs, Transport and Resources, CropPro website, http://www.croppro.com.au/crop_disease_manual/ch06.php

9.14.4 Management options

Integrated disease management (IDM) can minimise the presence of inoculum and protect against potential infection as the crop develops:

- Use crop rotation and careful paddock selection – allow 4 years between bean crops and control self-sown beans.
- Select resistant varieties (see Table 1).
- Sow disease-free seed (with no more than 5% infection).
- Use fungicide seed dressings (Table 4).
- Monitor crops regularly.
- Use fungicides strategically.

Seed dressings are not usually required, and only protect the emerging seedling from seed-borne Botrytis and common root rots. They will not protect the emerged seedling from raindrop-splashed Ascochyta or wind-borne Botrytis.

Fungicides used in faba and broad bean are protectants only. Unlike wheat stripe rust fungicides, they have no systemic action and will not eradicate an existing infection. To be effective they must be applied before infection i.e. before rain. The key to a successful Ascochyta spray program is regular monitoring combined with timely application of registered fungicides.

Specific spray programs have been developed based on varietal Ascochyta resistance ratings.

Currently Nura⁽ᴰ⁾ and PBA Samira⁽ᴰ⁾ are the only varieties with resistance to both pathotypes (Table 1). PBA Rana⁽ᴰ⁾ and PBR Zahra⁽ᴰ⁾ have partial resistance to pathotype 2 and will need to be carefully monitored with the use of protective fungicides during podding. Farah⁽ᴰ⁾ needs to be managed as a susceptible variety where pathotype 2 is likely to be found.

The Ascochyta pathogen can mutate to overcome plant resistance and all varieties should be monitored regardless of nominated resistance ratings.

For resistant varieties:

- Resistant varieties require fewer and later fungicide applications for Ascochyta control, if at all.
- Only consider applying an early foliar fungicide for Ascochyta blight if the disease is present and the risk is high. If not controlling Ascochyta blight be aware that control of chocolate spot may still be required to prevent early development.
- Resistant varieties have pod resistance. In most situations foliar fungicide during podding is not likely to be required to protect grain quality.

For susceptible varieties:

- Foliar sprays are likely to be economic in susceptible varieties.
- Fungicides will be required in most areas, commencing early.
- Apply in the first critical period (5–8 weeks after emergence) and before the disease is detected to reduce lodging losses from stem infections. Control is ineffective once the disease has taken hold.
- When conditions favour Ascochyta blight, fungicides will be required in all critical periods.
- Apply through to 4 weeks before maturity. Late sprays can reduce seed infection.

Strategic spraying with mancozeb is effective for disease management.

Mancozeb is a broad-spectrum fungicide and might need to be used through the season on varieties that are susceptible to Ascochyta blight. The withholding period for grain prior to harvest for mancozeb is 4 weeks.

Harvest at maturity to minimise Ascochyta blight and chocolate spot infection on seed. Infection, harvest losses and downgrading in quality can be substantial when bean harvest is delayed until moisture content is below 12%. Ascochyta blight can grow on dead plant tissue once wet, so infection on pods can spread to the seed if harvest is delayed and conditions are wet.

9.15 Chocolate spot (*Botrytis fabae*)

9.15.1 Symptoms

Symptoms are varied and range from small spots on the leaves to complete blackening of the entire plant. Leaves are the main part of the plant affected, but under favourable conditions for the disease it also spreads to stems, flowers and pods.[27]

Two stages of the disease are usually recognised. First, a non-aggressive phase, when discrete reddish-brown spots are peppered over the leaves and stems (Photo 7).

The second stage is an aggressive phase where tissue around the spots is rapidly killed leaving large, black or grey blighted sections on plant parts (Photo 8).

Small black sclerotia may sometimes be found inside the stems of badly diseased plants.

In moist conditions, the fruiting structures of this fungus may be visible, protruding as grey, hair-like formations from the surface of infected plant parts e.g. on the underside of diseased leaves (Photo 9).

Chocolate spot infecting the flowers can prevent pod-set (Photo 13 and Photo 14) and on the pods can cause seed staining (Photo 15).

Symptoms of chocolate spot can be confused with symptoms of Cercospora leaf spot or damage on leaves from herbicides or physical events, which then allow minor diseases such as Alternaria to infect.

Redlegged earth mite damage can also be mistaken for chocolate spot. This starts as silvery patches, which become red-brown, similar in colour to chocolate spot, but form large, irregularly shaped areas. Redlegged earth mite damage usually occurs during the seedling stage and on the lower leaves.

Correct identification of damage is necessary to avoid unnecessary spraying or incorrect fungicide use.

Photo 7: *Infections of chocolate spot on beans start as small brown spots.*

Photo: Grain Legume Handbook (2008), https://grdc.com.au/grainlegumehandbook

MORE INFORMATION

The CropPro webpage has information on chocolate spot of faba bean, see http://www.croppro.com.au/crop_disease_manual/ch06s02.php

27 G Hollaway, F Henry, M McLean, P Kant, H Li, S Marcroft, M Rodda, M Aftab, P Trebicki, J Fanning, A Van de Wouw, H Richardson, L Hamilton (2015) Diseases in pulses: faba bean. In Identification and Management of Field Crop Diseases in Victoria. Department of Economic Development, Jobs, Transport and Resources, CropPro website, http://www.croppro.com.au/crop_disease_manual/ch06.php

Photo 8: *Chocolate spot lesion showing some expansion across the leaf.*

Photo: Joop Van Leur, NSW DPI via Pulse Australia (2016), Southern faba & broad bean best management practices training course

Photo 9: *Chocolate spot showing lesion expansion and sporulation after a few days in humid chamber.*

Photo: Joop Van Leur, NSW DPI via Pulse Australia (2016), Southern faba & broad bean best management practices training course

Photo 10: *Poor pod-set and leaf loss from failing to protect against chocolate spot early.*

Photo: Pulse Australia (2016), Southern faba & broad bean best management practices training course

Photo 11: *Chocolate spot can cause thick parts of crop (e.g. headlands) to lodge.*

Photo: Grain Legume Handbook (2008), https://grdc.com.au/grainlegumehandbook

Photo 12: *Chocolate spot on stems.*

Photo: Grain Legume Handbook (2008), https://grdc.com.au/grainlegumehandbook

Photo 13: *Chocolate spot on flowers will prevent pod-set.*

Photo: SARDI via Pulse Australia (2016), Southern faba & broad bean best management practices training course

Photo 14: *Grey, dead areas of chocolate spot spread, and flowers are also blighted, stopping any pod-set.*

Photo: Grain Legume Handbook (2008), https://grdc.com.au/grainlegumehandbook

Photo 15: *Chocolate spot lesion on pod leading to infection and staining on seed.*

Photo: SARDI via Pulse Australia (2016), Southern faba & broad bean best management practices training course

9.15.2 Economic importance

Chocolate spot is the major disease of faba bean in southern Australia and occurs in all areas where faba bean is grown. Losses can be substantial depending on the seriousness of infection, the time at which infection occurs and the amount of spring rainfall. When chocolate spot develops it is very aggressive.

A 2012 GRDC survey estimated the incidence of chocolate spot is 54% of years and 62% of bean crops in the southern region.[28]

In unprotected crops pod-set can fail and the disease commonly reduces yields by 30–50% in a bad year. Seed from badly affected plants may have a reddish-brown stain that will lower its market value.

9.15.3 Disease cycle

The fungus may either survive as sclerotia in the soil or on crop debris, on self-sown volunteer plants, or occasionally on infected seed. It may be hosted by other crops, including vetch and lentil, and, to some extent, chickpea. In new bean-growing areas the disease often becomes established by sowing infected seeds. In subsequent years the initial infection usually occurs when spores formed on old bean trash are carried by wind into new crops. These spores may move long distances.

Once the disease becomes established it rapidly spreads within the crop. It spreads most aggressively in warm (15°C–25°C), humid conditions (>70%) that extend for 4–5 days.

28 GM Murray, JP Brennan (2012) The current and potential costs from diseases of pulse crops in Australia. GRDC Report, https://grdc.com.au/resources-and-publications/all-publications/publications/2012/06/the-current-and-potential-costs-from-diseases-of-pulse-crops-in-australia

It typically develops later in the season during flowering and after canopy closure when the environment becomes more humid. Yield loss due to chocolate spot results from pod abortion and plant damage (leaf infection and loss of leaf tissue).

Botrytis grey mould (BGM, *Botrytis cinerea*) can sometimes contribute to chocolate spot.

The disease cycle is shown in Figure 5.

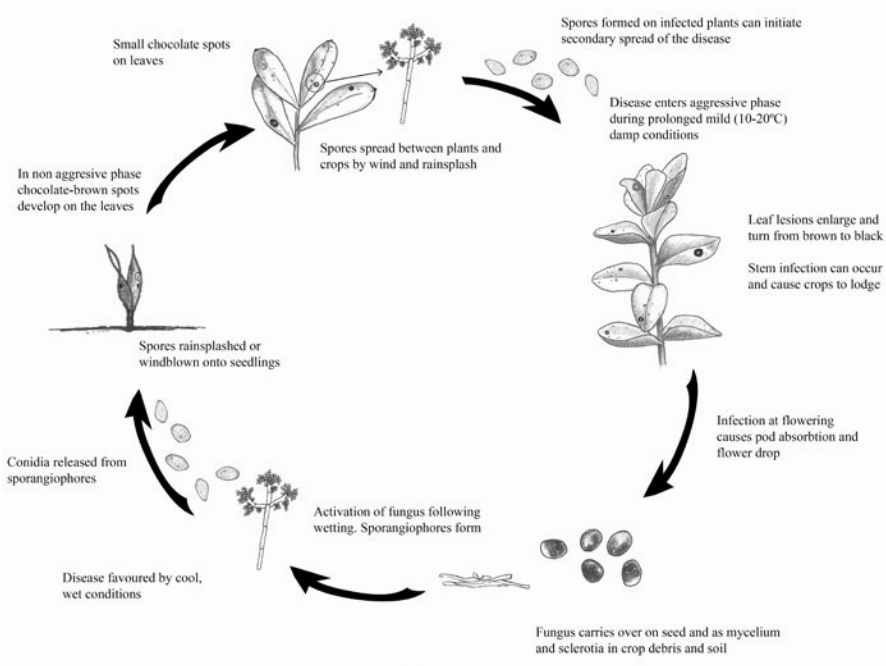


Figure 5: *Disease cycle of chocolate spot on faba bean.*

Illustration by Kylie Fowler from Hollaway *et al* (2015), Diseases in pulses: faba bean. In Identification and Management of Field Crop Diseases in Victoria. Department of Economic Development, Jobs, Transport and Resources, CropPro website, http://www.croppro.com.au/crop_disease_manual/ch06.php

9.15.4 Management options

The most effective method of control is to use a less susceptible variety, particularly in areas where the likelihood of chocolate spot is high. There are no resistant varieties.

Crops are at high risk of chocolate spot if one or more of the following conditions is met:

- sown early, producing bulky canopy;
- sown in a high-rainfall area;
- spring rains are forecast; or
- disease has established in the lower canopy.

Follow the principles of integrated disease management (IDM), those with particular benefit for managing chocolate spot include:

- Use crop rotation – allow 4 years between bean crops.
- Select paddocks carefully, ensuring 500 m from the previous year's bean stubble and not adjacent to vetch, lentil or chickpea stubble. Destroy bean trash and self-sown plants if this is not possible.
- Grow less suceptible varieties (see Table 1).
- Delay sowing.
- Sow disease-free seed (with no more than 10% infection).
- Use fungicide seed dressings.

- Practice canopy management through time of sowing, seeding rate and row spacing.
- Monitor crops regularly.
- Practice strict hygiene on and off farm.
- Use foliar fungicides strategically.

Seed dressings are not usually required, and only protect the emerging seedling from seed-borne Botrytis and common root rots. They will not protect the emerged seedling from raindrop-splashed Ascochyta blight or wind-borne Botrytis.

Sowing later can be reduce disease pressure as the crop will have a lower biomass, a more open canopy and be growing in warmer and drier weather. The trade-off in yield may be offset by reduced disease pressure and control costs. However, this increases the risk of a dry and sharp finish to the season.

Fungicides for chocolate spot include mancozeb, chlorothalonil, carbendazim or procymidone. Copper products may have some efficacy.

When chocolate spot pressure is high or the disease is spreading in the crop, then carbendazim or procymidone are more effective than chlorothalonil, mancozeb or copper. Label regulations limit carbendazim to a maximum of two consecutive sprays at 14-day intervals.

It is essential to control chocolate spot before it has a significant impact on crop yield. Check for disease every seven days while the temperature remains below 15°C. If the weather is mild with day temperatures between 15°C and 20°C and humidity over 70% in-crop inspections should be made every 3 days, typically from early spring.

Infections can start earlier and crops should be monitored from late winter.

Chocolate spot is targeted by fungicide sprays in critical period 2 and critical period 3. Spraying could begin at early flowering as a protective spray that is able to penetrate the canopy.

Follow-up sprays will be necessary where:

- chocolate spot lesions are visible within the upper canopy; or
- relative humidity in the crop is likely to remain high for at least a week; or
- disease is increasing.

Fungicides are generally only protectants with little or no systemic activity. Most will not eradicate an existing infection. Procymidone has some systemic activity, and carbendazim has some limited systemic activity that should not be relied upon.

To be effective, all these fungicides must be applied before infection and spread, i.e. before rain.

All varieties will require fungicide spray before canopy closure when conditions or location are ideal for infection. Further applications are required under wet conditions particularly if symptoms are evident, soil moisture is high and the crop canopy is dense.

The recommended spray program depends on each variety's chocolate spot resistance rating.

For moderately susceptible (MS) varieties:

- Apply an early foliar fungicide for chocolate spot just before canopy closure or before flowering if the disease is present or the risk is deemed high.
- Repeat foliar fungicide will likely need to be applied during flowering and podding to ensure leaves are retained clean of lesions.
- Application at late podding may be required to protect grain quality in high-risk situations or if the disease is present. Note that these varieties will have minimal Botrytis in the pods and seeds if the leaf canopy is kept clean of the disease.
- Varieties with moderate susceptibility to chocolate spot may require the same number of fungicide applications as a susceptible variety. The disease does

move slower, but will be devastating if left unprotected in medium to high disease pressure situations.

For susceptible (S) varieties:

- Apply an early foliar fungicide for chocolate spot just before canopy closure or before flowering if the disease is present or the risk is deemed high.
- Repeat foliar fungicide applications likely will be required during flowering and podding until flowering is completed and no more new growth occurs.
- Ensure leaves are retained clean of lesions so that grain can be filled and to protect grain quality in high risk or disease pressure situations.
- Note that these varieties will have minimal Botrytis in the pods if the leaf canopy is kept clean of the disease.

For very susceptible (VS) varieties:

- Regular foliar fungicide applications for chocolate spot control will be necessary in most areas, commencing early and applying before a prolonged rainfall event. This is critical, as control is often ineffective if fungicides are applied after the disease has taken hold.
- Apply a fungicide before the disease is detected, from the commencement of flowering until 4 weeks before maturity.

Harvest at maturity to minimise chocolate spot infection on seed. Seed infection is usually more severe when crops are harvested late and is more likely when harvest is delayed until moisture content is below 12%.

FEEDBACK

MORE INFORMATION

The CropPro webpage has information on rust of faba bean, see http://www.croppro.com.au/crop_disease_manual/ch06s06.php

9.16 Rust (*Uromyces viciae-fabae*)

9.16.1 Symptoms

Leaves have numerous small, orange-brown pustules, surrounded by a light yellow halo (Photo 16).[29] As the disease develops, severely infected leaves wither and drop off.

Rust pustules on the stems are similar, but often larger, than those on the leaves (Photo 17). Late in the season, stem lesions darken as resting spores of the fungus are produced in pustules.

Isolated rust pustules may also appear on the pods. A severe rust infection may cause premature defoliation, resulting in smaller seeds.

Photo 16: *Bean rust shows as orange 'bumps' on leaves.*

Photo: SARDI via Pulse Australia (2016), Southern faba & broad bean best management practices training course

Photo 17: *Rust on faba bean stem.*

Photo: Grain Legume Handbook (2008), https://grdc.com.au/grainlegumehandbook

29 G Hollaway, F Henry, M McLean, P Kant, H Li, S Marcroft, M Rodda, M Aftab, P Trebicki, J Fanning, A Van de Wouw, H Richardson, L Hamilton (2015) Diseases in pulses: faba bean. In Identification and Management of Field Crop Diseases in Victoria. Department of Economic Development, Jobs, Transport and Resources, CropPro website, http://www.croppro.com.au/crop_disease_manual/ch06.php

9.16.2 Economic importance

Rust occurs sporadically in the southern region. Rust epidemics can significantly reduce faba bean yields. Rust often occurs in years with good spring rainfall and mild temperatures. A 2012 GRDC survey estimated the incidence of rust is 20% of years and 30% of bean crops in the southern region.[30]

Rust has the potential to reduce seed size. On its own the disease has caused losses of up to 30%. In combination with chocolate spot yield reductions may be up to 50%.

9.16.3 Disease cycle

The fungus survives on stubble trash and infects self-sown bean plants directly without the need for alternate hosts. Infection of volunteer faba bean plants is thought to be an important factor in the early development of rust epidemics. Rust spores are blown long distances onto new crops by the wind.

Rust pustules form on the first few plants to be infected and the disease spreads from these to other plants.

Rust can occur from early to mid-spring onwards and is favoured by humidity and warm temperatures (>20°C). Infection can follow just 6 hours of leaf wetness and does not require extended wet periods.

Rust commonly occurs late in the growing season during podding, resulting in premature leaf drop that can reduce seed weight and size.

The same species also causes rust on vetch and lentil.

9.16.4 Management options

Prevention of rust is difficult because the fungus spores can be carried long distances by wind to infect crops far away from the initial source of infection.

Control options for rust include:

- Crop rotation – allow 4 years between bean crops.
- Select paddocks carefully, ensuring 250 m from the previous year's bean stubble. Burn or bury old bean stubbles.
- Growing resistant varieties is ideal because rust spores can travel long distances, however the current southern varieties have limited resistance (see Table 1).
- Delay sowing – late planting is recommended in high-risk areas.
- Monitor crops regularly.
- Use foliar fungicides aimed at control of other diseases.

Foliar sprays of mancozeb provide the added benefit of suppressing chocolate spot and Ascochyta blight later in the season. Copper sprays will control rust and chocolate spot.

Where there is a high risk of rust infection fungicides may be required before flowering. Fungicide to control rust may be applied at the same time as chocolate spot is being targeted. In areas where the disease is most prevalent (northern NSW) several sprays are necessary for control.

30 GM Murray, JP Brennan (2012) The current and potential costs from diseases of pulse crops in Australia. GRDC Report, https://grdc.com.au/resources-and-publications/all-publications/publications/2012/06/the-current-and-potential-costs-from-diseases-of-pulse-crops-in-australia

FEEDBACK

MORE INFORMATION

The CropPro webpage has details on Cercospora leaf spot of faba bean, see http://www.croppro.com.au/crop_disease_manual/ch06s05.php

9.17 Cercospora leaf spot (*Cercospora zonata*)

9.17.1 Symptoms

Symptoms can be difficult to distinguish from those of chocolate spot or Ascochyta blight.

Cercospora leaf spot first appears as dark, round lesions soon after emergence and may merge rapidly to form irregular blighting on leaves (Photos 18 and 19). Cercospora leaf spot lesions tend to be confined to lower leaves of plants and do not affect flowers.

Cercospora leaf spot lesions are generally darker than those of chocolate spot, with irregular shaped edges.[31] Within the spots a concentric ring pattern can often be seen. Cercospora leaf spot lesions do not have pycnidia, which distinguish them from Ascochyta blight, but light-grey fruiting structures with a short furry covering may be visible within lesions.

Severe infection leads to defoliation of leaves. Occasionally stem lesions will also occur but these tend to be superficial.

Damage on leaves from herbicides or physical events may look similar and can allow minor diseases such as Alternaria (*Alternaria alternata*) to infect plants. Correct disease identification is important to avoid unnecessary spraying or incorrect fungicide use.

Photo 18: *Cercospora leaf spot lesions on faba bean.*

Photo: SARDI via Pulse Australia (2016), Southern faba & broad bean best management practices training course

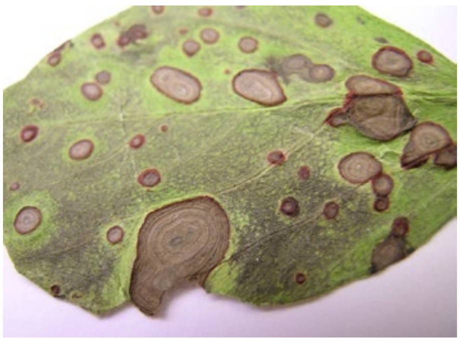


Photo 19: *Cercospora leaf spot lesions on faba bean.*

Photo: SARDI via Pulse Australia (2016), Southern faba & broadb ean best magenemt practices training course

31 G Hollaway, F Henry, M McLean, P Kant, H Li, S Marcroft, M Rodda, M Aftab, P Trebicki, J Fanning, A Van de Wouw, H Richardson, L Hamilton (2015) Diseases in pulses: faba bean. In Identification and Management of Field Crop Diseases in Victoria. Department of Economic Development, Jobs, Transport and Resources, CropPro website, http://www.croppro.com.au/crop_disease_manual/ch06.php

9.17.2 Economic importance

Cercospora zonata is ubiquitous in southern Australia and sporadic outbreaks result from the right seasonal conditions. Lesions will reach the top of the plant in wet springs and yield loss of 5–10% has been reported. It will become a regular occurrence and need early control in faba bean crops that are growing in a paddock that has had a recent or prolonged history of growing faba beans.

A 2012 GRDC survey estimated the incidence of cercospora leaf spot is 63% of years and 49% of bean crops in the southern region.[32] The incidence and severity is believed to be on the increase.

9.17.3 Disease cycle

Cercospora leaf spot disease has not been well studied. It can also affect vetch, narbon bean and possibly lentil.

Cercospora is soil-borne and prevalent in paddocks with a history of faba bean, particularly where they are grown more frequently than 4–6 years or within close proximity of other bean crops.

Cercospora it is not known to be seed-borne, but survives on old bean trash and spores are spread passively by wind or rain-splash. Disease spread is limited to short distances within a paddock from carryover of the fungus on the trash. Spores do not spread long distances to other paddocks but may be carried in soil or on debris distributed by strong wind events.

Cercospora, like Ascochyta blight, develops early in the season during wet and cold conditions but is less damaging. The disease can develop later in the season and if uncontrolled can cause extensive defoliation.

The disease often occurs when plants are grown in wet patches, particularly where free water remains on the soil surface.

9.17.4 Management options

All current faba bean varieties are susceptible to Cercospora leaf spot. Breeding resistant varieties is an aim of the current Australian faba bean breeding program.

The severity of Cercospora leaf spot appears to be strongly linked to close faba bean rotation. Wide rotations of susceptible crops (allow 4–6 years) and good crop hygiene are the best means of cultural control.

Fungicide application for protection from Cercospora leaf spot must start early (5–8 weeks post-emergence) before lesions develop. Use tebuconazole (under permit) to prevent Cercospora leaf spot establishing in a crop.

32 GM Murray, JP Brennan (2012) The current and potential costs from diseases of pulse crops in Australia. GRDC Report, https://grdc.com.au/resources-and-publications/all-publications/publications/2012/06/the-current-and-potential-costs-from-diseases-of-pulse-crops-in-australia

FEEDBACK

MORE INFORMATION

The CropPro webpage has information on Alternaria leaf spot of faba bean, see http://www.croppro.com.au/crop_disease_manual/ch06s04.php

9.18 Alternaria (*Alternaria alternata*)

9.18.1 Symptoms

Alternaria appears as dark brown leaf spots, often with a zoned pattern of concentric brown rings with dark margins (Photo 20).[33] Symptoms can be confused with chocolate spot or Cercospora leaf spot. It can also be confused with Ascochyta blight, but does not produce black pycnidial fruiting structures within leaf lesions.

Photo 20: *Alternaria lesions have concentric rings with lesions.*

Photo: Hollaway *et al.* (2015), Cereal root disease management in Victoria. GRDC Update Papers, 24 February 2015, https://grdc.com.au/Research-and-Development/GRDC-Update-Papers/2015/02/Cereal-root-disease-management-in-Victoria

9.18.2 Economic importance

Alternaria is a minor disease occurring late in the season. A 2012 GRDC survey estimated that Alternaria has minimal incidence in minimal years in the southern region.[34]

9.18.3 Disease cycle

Alternaria is a weak pathogen of many hosts and infection often follows insect damage or other leaf spots caused by rust or chocolate spot. It develops late in the season as the plants start to mature. The fungus is thought to survive on crop residues and on other hosts.

9.18.4 Management options

Control of Alternaria alone is not warranted. There is no fungicide-efficacy data for Alternaria on faba bean and no registered products. However, sprays aimed at other major pathogens may give control.

33 Pulse Australia (2016) Southern faba & broadbean best management practices training course – 2016. Pulse Australia.

34 GM Murray, JP Brennan (2012) The current and potential costs from diseases of pulse crops in Australia. GRDC Report, https://grdc.com.au/resources-and-publications/all-publications/publications/2012/06/the-current-and-potential-costs-from-diseases-of-pulse-crops-in-australia

MORE INFORMATION

GRDC Updates: The 'watch outs' for pulse diseases in 2017 https://grdc.com.au/resources-and-publications/grdc-update-papers/tab-content/grdc-update-papers/2017/02/the-watch-outs-for-pulse-diseases-in-2017

9.19 Sclerotinia stem rot (*Sclerotinia trifoliorum var. fabae, S. sclerotiorum, S. minor*)

9.19.1 Symptoms

Plants can be attacked at any stage of growth. Usually, isolated plants are infected rather than multiple plants in patches.[35]

In young plants the infection usually begins close to ground level and a slimy, wet rot extends into the stem and down into the roots. Affected plants are easily pulled from the soil. They usually have a blackened base that is covered with cottony, white fungal growth.

Older plants can get the infection on any part of their stems, leaves or pods. Infected plants suddenly wilt and collapse.

Sclerotes (2–5 mm in diameter) form on the surface of infected plants and in the central cavity of the stem. These sclerotes are usually white at first then turn black.

9.19.2 Economic importance

Crop losses in Australia have been small so far. A 2012 GRDC survey estimated the incidence of Sclerotinia stem rot is 11% of years and 7% of bean crops in the southern region.[36] However, the disease poses a potential threat.

9.19.3 Disease cycle

The fungus can survive in the soil for several years. It has a wide host range, including oilseed crops, and may survive on other plants even if beans are not grown.

Sclerotinia may act as either a leaf or root disease. The foliar form of the disease may be spread by air-borne spores. Infection begins when these spores settle on the crop. If conditions are cool and wet, the disease develops rapidly and affected plants soon wilt and die.

The fungus infects damaged tissue more easily but can also infect uninjured tissue.

Root disease occurs when soil-borne spores directly invade the root tissue. A slimy, wet root rot develops and the infected plants suddenly wilt and die.

9.19.4 Control

Crop rotation prevents rapid disease build-up, but once established in a crop it is difficult to control. Rotations with other legumes and oilseed crops will not break the disease cycle. Cereal crops are not hosts and are a suitable break crop.

Lower seeding rates, wider row spacing and good weed control give a more open crop, which remains drier and is less prone to disease.

35 Pulse Australia (2016) Southern faba & broad bean best management practices training course – 2016. Pulse Australia.

36 GM Murray, JP Brennan (2012) The current and potential costs from diseases of pulse crops in Australia. GRDC Report, https://grdc.com.au/resources-and-publications/all-publications/publications/2012/06/the-current-and-potential-costs-from-diseases-of-pulse-crops-in-australia

VIDEO

GRDC Video: Botrytis in Chickpeas
https://youtu.be/P7C9g2eRw80

9.20 Botrytis grey mould (BGM) (*Botrytis cinerea*)

9.20.1 Symptoms

The life cycle and symptoms of Botrytis grey mould (BGM) are similar to those of chocolate spot.[37]

As with chocolate spot, flowers are especially vulnerable to BGM infection.

9.20.2 Economic importance

BGM is a minor disease in faba bean compared with chocolate spot (*Botrytis fabae*) in southern Australia, but the two are sometimes found together in association. A 2012 GRDC survey estimated the incidence of BGM is 54% of years and 62% of bean crops in the southern region.[38]

Discoloured seed may be rejected or heavily discounted when offered for sale. If seed infection levels are higher than 5% then it may be worth grading the seed.

9.20.3 Disease cycle

BGM is a significant pathogen of other pulse crops particularly lentil and chickpea, and it has been recorded on over 138 genera of plants in 70 families. BGM does not infect cereals or grasses.

As well as being a serious pathogen, *B. cinerea* can infect and invade dying and dead plant tissue. This wide host range and saprophytic capacity means inoculum of *B. cinerea* is almost always present. If conditions favour infection and disease development, BGM will occur.

This makes management of BGM different from Ascochyta blight, which is more dependent on inoculum, at least in the early phases of an epidemic.

Occurrence is worst in wet seasons, particularly when crops develop very dense canopies.

9.20.4 Management options

The only fungicide specifically registered for control of BGM in faba bean is carbendazim.

37 Pulse Australia (2016) Southern faba & broad bean best management practices training course – 2016. Pulse Australia.

38 GM Murray, JP Brennan (2012) The current and potential costs from diseases of pulse crops in Australia. GRDC Report, https://grdc.com.au/resources-and-publications/all-publications/publications/2012/06/the-current-and-potential-costs-from-diseases-of-pulse-crops-in-australia

FEEDBACK

MORE INFORMATION

A Horticulture Australia report on Aphanomyces in bean is at http://ausveg.com.au/insights-database/development-of-methods-to-monitor-and-control-aphanomyces-root-rot-and-black-root-rot-of-beans

9.21 Aphanomyces root rot (*Aphanomyces euteiches* f.sp. *phaseoli*)

9.21.1 Symptoms

Chlorosis and wilting of the plant, associated with necrosis in the roots. Roots show discolouration and the absence of nodulation.[39] Diseased plants are likely to appear in clusters within waterlogged areas. It can be confused with other types of root rot (see Section 9.22 Other root rots).

Photo 21: *Faba bean affected by Aphanomyces euteiches.*

Photo: J van Leur, NSW DPI via Yeatman *et al*. (2009), Faba Beans: The Ute Guide. Primary Industries and Resources South Australia, https://grdc.com.au/resources-and-publications/allpublications/publications/2009/11/faba-beans-the-ute-guide/

9.21.2 Economic importance

This root rot is common in parts of northern NSW and has also been detected in Tasmania in bean-growing soils. A 2012 GRDC survey estimated the incidence of Aphanomyces is 3% of years and 3% of bean crops in the southern region.[40]

It is unlikely to be a major pathogen of faba bean at the present. However, the expansion of this crop in regions with heavy soils and high rainfall or irrigation will increase the risk of losses. Infection by Aphanomyces can also predispose plants to infection by secondary fungi including *Pythium*, *Rhizoctonia* and *Fusarium* species.[41]

9.21.3 Disease cycle

The fungus survives in soil and is exacerbated by waterlogging. It can spread from crop to crop in the soil, either via infected plant debris or as resting spores.

39 Pulse Australia (2016) Southern faba & broad bean best management practices training course – 2016. Pulse Australia.

40 GM Murray, JP Brennan (2012) The current and potential costs from diseases of pulse crops in Australia. GRDC Report, https://grdc.com.au/resources-and-publications/all-publications/publications/2012/06/the-current-and-potential-costs-from-diseases-of-pulse-crops-in-australia

41 A Watson, H Pung, A McKay (2013) Development of methods to monitor and control Aphanomyces root rot and black root rot of beans, VG08043 Final report. Horticulture Australia Ltd, http://ausveg.com.au/insights-database/development-of-methods-to-monitor-and-control-aphanomyces-root-rot-and-black-root-rot-of-beans

In wet soils these fungi invade plant roots and cause root rot. Wet conditions also encourage the spread of disease within a field. The reduced root development causes the plants to die when they are stressed.

9.21.4 Management options

The disease can be reduced by crop rotation. Cross-infection with other hosts is not fully understood, but initial studies show that bean isolates do not infect peas. No cost-effective options are available for identification prior to planting.

MORE INFORMATION

GRDC Fact Sheet: Pythium root rot, www.grdc.com.au/GRDC-FS-PythiumRootRot

9.22 Other root rots, including Phoma blight and damping-off (*Fusarium*, *Rhizoctonia*, *Pythium* spp. and *Phoma medicaginis* var *pinodella*)

9.22.1 Symptoms

Root rot is the most common symptom of Phoma blight, as plants can be infected on the stem below ground level. Lesions on the stems below soil level are black. Infected plants are stressed.

Seedlings affected by root rot gradually turn black and leaves droop. The plants usually don't collapse completely. The taproot may become quite brittle, except in Pythium root rot when it becomes soft. When plants are pulled from the ground the lower portion of the root snaps off and remains in the soil. The upper portion of the taproot is dark, shows signs of rotting and may lack lateral roots. Distinct, dark-brown to black lesions may be visible on the taproot.

The leaves and stems of affected plants usually start turning black. Older plants dry-off prematurely and are often seen scattered across a field. In some cases, seeds may rot before they emerge.

9.22.2 Economic importance

Root rot can occasionally be a serious disease especially when soils are wet for prolonged periods. Severe pod infection can result in reduced seedset and infected seed. A 2012 GRDC survey estimated the incidence of root rots ranges from 0–18% of years and 0–16% of bean crops in the southern region, depending on the causal agent.[42]

9.22.3 Disease cycle

All the fungi responsible for root rot are soil-dwellers. They can survive from crop to crop in the soil, either on infected plant debris or as resting spores.

Soil-borne fungi invade the roots and stem base of young plants, particularly under wet conditions. Wet conditions also encourage the spread of disease within a field. However, recent research has shown that Pythium does not require high rainfall or cold, waterlogged soils.[43] The reduced root development causes the plants to die when they are stressed.

During wet weather the disease may spread further, when fungal spores are carried onto neighbouring plants by wind and rain-splash.

42 GM Murray, JP Brennan (2012) The current and potential costs from diseases of pulse crops in Australia. GRDC Report, https://grdc.com.au/resources-and-publications/all-publications/publications/2012/06/the-current-and-potential-costs-from-diseases-of-pulse-crops-in-australia

43 GRDC (2010) Pythium root rot. Root disease Fact Sheet. GRDC, May 2010, https://grdc.com.au/GRDC-FS-PythiumRootRot

9.22.4 Management options

The disease can be reduced by crop rotation. As this disease may also affect other pulses it is recommended to rotate with non-legume crops.

Disease risk can be reduced by using fresh, undamaged and robust seed to prevent disease build-up. Avoid areas subject to waterlogging. Damping-off can be controlled using fungicide seed treatment, but this is not common practice in faba and broad bean.

Pythium root rot can be detected with a SARDI PreDicta B® soil test prior to sowing.

MORE INFORMATION

A GRDC media release on leaf blight can be found at https://grdc.com.au/Media-Centre/Media-News/North/2016/08/Mild-wet-winter-leads-to-emergence-of-leaf-blight

9.23 Stemphylium blight (*Stemphylium botryosum*)

9.23.1 Symptoms

Stemphylium blight is characterised by large, grey-black, necrotic lesions, restricted to the leaves, often starting from the leaf edge.[44]

It differs from chocolate spot, the symptoms of which are small, discrete, reddish-brown lesions on leaves, that form after extended periods of leaf wetness and increase rapidly, causing severe leaf necrosis, as well as symptoms on stems, flowers and pods.

9.23.2 Economic importance

Stemphylium is considered a minor disease of faba bean in Australia, although it is common in lucerne and can cause severe defoliation. In 2016 the mild, wet winter led to an unusually high number of reports of stemphylium on faba bean in northern NSW. A 2012 GRDC survey did not estimate the incidence of stemphylium.

9.23.3 Disease cycle

Stemphylium botryosum occurs on lucerne, clovers, lupin, bean and tomato. In lucerne Stemphylium can be carried over on infected plant debris, seed and in soil. The disease is favoured by warm, moist conditions and spores are spread by wind or rain-splash.

9.23.4 Management options

As a minor disease no control is generally required.

44 S Jeffrey (2016) Mild, wet winter leads to emergence of leaf blight. GRDC media release, 18 August 2016, http://www.dpi.nsw.gov.au/content/agriculture/broadacre/pests-diseases/winter-crops-lupins-chickpeas-other-pulses/stemphylium-blight-in-faba-bean

FEEDBACK

MORE INFORMATION

Plant Health Australia fact sheet: Stem nematode, http://www.planthealthaustralia.com.au/wp-content/uploads/2013/01/Stem-nematode-FS.pdf

APPS fact sheet: Ditylenchus dipsaci, http://www.appsnet.org/publications/potm/pdf/Mar11.pdf

9.24 Stem nematode (*Ditylenchus dipsaci*)

9.24.1 Symptoms

Symptoms in faba bean are only seen in seedlings.[45] Heavy infections will show up as poor germination and emergence with patches of malformed and stunted plants (Photo 22).

The malformation, curling of leaves and water-soak spots are often confused with herbicide damage. Sometimes the stem will die back, turning reddish-brown from the base and stopping at a leaf.

Photo 22: *Stem nematode causes stunting and twisting of leaves. Black streaks down stems are also a symptom.*

Photo: Grain Legume Handbook (2008), https://grdc.com.au/grainlegumehandbook

9.24.2 Economic importance

Stem nematode is a soil-borne pest of oat, pulse and some pasture crops.[46] In South Australia and Victoria there are three different races of the nematode: the oat, lucerne and clover races. The oat race infects the cultivated and wild oat, faba bean and field pea and has been recorded on lentil, chickpea and canola seedlings.

Access to some international and domestic markets requires seed to be tested and found free of stem nematode.

A 2012 GRDC survey estimated the incidence of stem nematode is 6% of years and 5% of bean crops in the southern region.[47]

A heavy infestation of this nematode can cause large yield losses, but this has occurred only rarely.

45 Plant Health Australia (2013) Stem nematode fact sheet. Plant Health Australia, http://www.planthealthaustralia.com.au/wp-content/uploads/2013/01/Stem-nematode-FS.pdf

46 Plant Health Australia (2013) Stem nematode fact sheet. Plant Health Australia, http://www.planthealthaustralia.com.au/wp-content/uploads/2013/01/Stem-nematode-FS.pdf

47 GM Murray, JP Brennan (2012) The current and potential costs from diseases of pulse crops in Australia. GRDC Report, https://grdc.com.au/resources-and-publications/all-publications/publications/2012/06/the-current-and-potential-costs-from-diseases-of-pulse-crops-in-australia

MORE INFORMATION

GRDC Fact Sheet: Plant parasitic nematodes, http://www.grdc.com.au/GRDC-FS-Plant-Parasitic-Nematodes-SW

A Soil Quality fact sheet on root-lesion nematode is at http://soilquality.org.au/factsheets/root-lesion-nematode

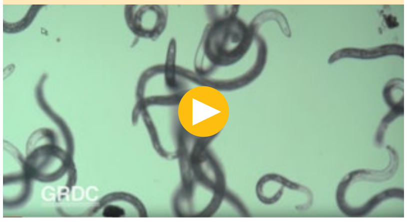
The SARDI webpage has information on PreDicta B® testing http://pir.sa.gov.au/research/services/molecular_diagnostics/predicta_b

VIDEO

GRDC Video: Root-lesion nematodes https://youtu.be/Ntf08QGXPI0

VIDEO

GRDC Video: Root-lesion Nematodes. Resistant cereal varieties have surprising impact on RLN numbers https://youtu.be/1dt64MfUmOc



9.24.3 Life cycle

Stem nematode infects bean crops from infested seed, straw or soil. The nematode can survive for many years in seed, straw or soil without having to infect plants.

It infects above-ground parts of plants and can multiply many times during the growing season. Disease build-up is worse in wetter soils and at temperatures below 15°C.

It is more common in high-rainfall areas on clay soil.

9.24.4 Management options

There are no chemical options for managing nematodes. Hygiene is very important. Do not introduce the nematode onto the farm or into clean paddocks. Test seed for the presence of stem nematode with a SARDI seed test. Do not bring oaten hay or straw from infested areas onto the property.

Rotate with non-host crops such as wheat and barley to reduce nematode numbers.

Soil-borne disease risk can be assessed through the SARDI PreDicta B® soil test.

9.25 Root-lesion nematodes (RLN) (*Pratylenchus neglectus*, *P. thornei* and other *Pratylenchus* spp)

Faba bean is grown as a rotational crop to reduce the population of root-lesion nematodes (RLN) in the soil.

9.25.1 Symptoms

There are few symptoms above ground in faba bean, but diseased plants usually have shorter lateral roots and fewer root hairs.

Diagnosis can be difficult and the presence of RLN in the soil can only be confirmed with a SARDI PreDicta B® soil test to identify the particular RLN species.

9.25.2 Economic importance

There is minimal yield loss in the bean crop.

Root-lesion nematodes can cause large grain yield losses in susceptible crops such as wheat and chickpea.[48] At least 20% of cropping paddocks in south-eastern Australia have populations of RLNs high enough to reduce yield. The extent of yield loss is directly related to the population density at sowing.

Worldwide, the genus *Pratylenchus* is the second most important group of plant-parasitic nematodes, with more than 90 species of RLN known worldwide. The two main species of RLN in Australia's southern region are *Pratylenchus neglectus* and *P. thornei*.

P. teres and *P. penetrans* are found in the western region.

More than one RLN species can be found in the roots of an individual crop, although one species usually dominates.[49] Identification is important as different crops have different resistance or susceptibility depending on the *Pratylenchus* type. All species of *Pratylenchus* have a wide host range.

The estimated incidence of RLN in faba bean was not quantified in the 2012 GRDC study on the cost of diseases in Australia. However, SARDI have published results of recent PreDicta B® soil tests for root-lesion nematode.

48 G Hollaway (2013) Cereal Root Diseases. Agnote AG0562, Agriculture Victoria, http://agriculture.vic.gov.au/agriculture/pests-diseases-and-weeds/plant-diseases/grains-pulses-and-cereals/cereal-root-diseases

49 GRDC (2010) Root-lesion nematodes Fact Sheet. GRDC, Southern Region, February 2015, https://grdc.com.au/Resources/Factsheets/2015/03/Root-Lesion-Nematodes

VIDEO

DPIRD video: How to diagnose root-lesion nematode
https://youtu.be/ttFltE-B4qA

9.25.3 Life cycle

Nematodes are small worm-like organisms less than 1 mm in length that are able to move freely through moist soils and young root tissues. As the females move through plants they feed on the plant roots, causing lesions, and depositing eggs.

There may be 3–5 generations of nematodes within a growing season. Nematodes are likely to multiply under a range of host crops such as wheat and chickpea. Barley is only moderately susceptible. Many grass weeds and legumes can also host the nematode.

The nematode survives over the summer months in dry soil and root residues to become active again when the winter rains start.

Nematodes will not move great distances unless they are spread by surface water, soil on farm machinery or wind-blown soil in summer.

9.25.4 Management options

There are no chemical options for managing nematodes. Rotation of susceptible crops (e.g. cereals, chickpea) with resistant crops such as lentil, faba bean, field pea or lupin is the most important management tool for RLN.

Resistant crops reduce the population of nematodes in the soil. Tolerant crops do not reduce the population, but are less vulnerable to damage from nematodes.

Resistant crop species can reduce nematode populations by up to 50% per year. A 2 or more year break from susceptible crops may be necessary to minimise yield loss if nematode numbers are high. Resistant varieties of susceptible crop species should be grown in the following years.

With the exception of chickpea, pulses tend to have good resistance to *P. neglectus* and *P. thornei*, so can reduce nematode populations in cropping rotations (Table 8).

Resistant crops may differ in their capacity to host *P. neglectus* or *P. thornei,* so tailor rotations to manage the predominant species. Crops such as field pea and lentil provide some control for *P. thornei*, while faba bean, field pea and lentil provide control for *P. neglectus*.

Controlling volunteer crops and host weeds is also important. Weeds that can host nematodes include wild oat, barley grass, brome grass and wild radish and *Brassica tournefortii*.

Nematode numbers increase where susceptible crops like chickpea and wheat are grown in rotation.

Reducing the nematode population can lead to higher yield in subsequent cereal crops. Yield loss in south-eastern Australia from RLN is lower than in northern Australia.

The simplest way to identify a nematode problem is with a SARDI PreDicta B® soil test prior to sowing.

FEEDBACK

MORE INFORMATION

GRDC Fact Sheet: Aphids and viruses in pulses, http://www.grdc.com.au/GRDC-FS-AphidsandVirusesinPulses

The Pulse Australia webpage has information on managing viruses in pulses, see http://pulseaus.com.au/growing-pulses/publications/manage-viruses

The Agriculture Victoria webpage has information on managing viruses in pulse crops http://agriculture.vic.gov.au/agriculture/pests-diseases-and-weeds/plant-diseases/grains-pulses-and-cereals/managing-viruses-in-pulse-crops

Table 8: Resistance and tolerance of pulses to the major **Pratylenchus** species.

Crop	*Pratylenchus neglectus*		*Pratylenchus thornei*	
	Resistance	**Tolerance**	**Resistance**	**Tolerance**
Faba bean	R	-	MR	MI
Chickpea	S - MR*	MI - T*	VS - R*	MI - T*
Field pea	R	-	R	T
Lentil	R	T	R	MT
Vetch				
Blanchefleur	MR	T	S	I - MI
Languedoc	MR	T	MS	I - MI
Morava⁽ᵈ⁾	MR	T	MS	I - MI

* Chickpea varieties have a range of resistances and tolerances to *Pratylenchus* species.

Source: Pulse Australia (2016)[50]

9.26 Viruses

9.26.1 Viruses in pulses

Faba and broad bean are naturally infected by around 50 viruses worldwide, and the number continues to increase. Fortunately, only a few are of major economic importance in Australia (Table 9). Viruses can become a problem in bean crops in some seasons.

Major viruses that are known to infect faba and broad bean in Australia include:

- Bean leaf roll virus (BLRV)
- Beet western yellows virus (BWYV), also known as Turnip yellows virus (TuYV)
- Soybean dwarf virus (SbDV), also known as Subterranean clover red leaf virus (SCRLV)
- Sub clover stunt virus (SCSV)
- Bean yellow mosaic virus (BYMV)
- Pea seed-borne mosaic virus (PSbMV).

Less common viruses that occur in Australia are:

- Clover yellow vein virus (ClYVV)
- Alfalfa mosaic virus (AMV)
- Tomato spotted wilt virus (TSWV)
- Broad bean wilt virus (BBWV)
- Cucumber mosaic virus (CMV).

50 Pulse Australia (2016) Southern faba & broad bean best management practices training course – 2016. Pulse Australia.

FEEDBACK

Table 9: Virus categories and general symptoms.

Virus	Aphid transmission	Seed transmission*	Visual symptom type	Visual symptoms	Virus type (genus)
AMV	Non-persistent	Yes	Shoot tip	Necrotic or chlorotic local lesions, sometimes mosaics that do not necessarily persist.	alfamovirus
BBWV	Non-persistent	No	Mosaic, shoot tip	Vein clearing, mottling and necrosis of shoot apex, plant wilts, mottled, malformed and stunted.	fabavirus
BLRV	Persistent	No	Top yellowing	Upward leaf-rolling accompanied by interveinal yellowing of older leaves and flowers abscissed.	luteovirus
BWYV	Persistent	No	Top yellowing	Interveinal yellowing of the older or intermediate leaves. Mild chlorotic spotting, yellowing, thickening and brittleness of older leaves.	luteovirus
BYMV	Non-persistent	Yes	Mosaic	Transient vein chlorosis followed by obvious green or yellow mosaic. Usually no leaf distortion.	potyvirus
CMV	Non-persistent	Yes	Shoot tip	Mosaics, stunting and possibly some chlorosis.	cucumovirus
ClYVV	Non-persistent	No	Shoot tip, mosaic	Mosaics, mottles or streaks, vein yellowing or netting.	potyvirus
PSbMV	Non-persistent	Yes	Mosaic	Systemic dark and light-green zonal leaf mottle, slight to moderate downward rolling of leaf margins. Distortions of leaf shape associated with mottle patterns. Seed markings.	potyvirus
SCRLV	Persistent	No	Top yellowing	Mild yellowing, stunting and reddening.	luteovirus
SCSV	Persistent	No	Top yellowing	Top yellows, tip yellows or leaf roll. Leaf size reduced, petioles and internodes shortened.	nanavirus
TSWV	Persistent	No	Shoot tip, mosaic	Necrotic and chlorotic local lesions, mosaic, mottling, leaf shape malformation, vein yellowing, ringspots, line patterns, yellow netting and flower colour-breaking.	tospovirus

*Seed transmission in faba bean is minimal for all viruses, but of no epidemiological significance. However, it is important for quarantine to keep foreign virus strains out of Australia.

Source: Pulse Australia (2016)[51]

The South Australian Research and Development Institute (SARDI) found relatively low virus infection rates in faba bean in SA in 2014 (Table 10). BWYV infected canola crops across Victoria, SA and NSW in 2014, but was only detected at a high infection rate in one crop in SA late in the season.

Table 10: Results of virus testing in South Australia in 2014.

Crop type	Number of crops or trials tested	Test period	Number of crops with positive virus tests (average % infection rate in brackets)					
			BWYV	PSbMV	CMV	AMV	BLRV	BYMV
Faba bean	24	Jul–Aug	6 (2%)	4 (4.5%)	0	1 (100%)	0	0
	19	Sep–Oct	11 (2%, 1 at 62%)	1 (6%)	0	0	0	0

Source: Kimber *et al* (2015)[52]

51 Pulse Australia (2016) Southern faba & broad bean best management practices training course – 2016. Pulse Australia.

52 R Kimber, J Davidson, M Rodda, M Aftab, J Paull (2015) Diseases of pulse crops in 2014. GRDC Update Papers, 10 February 2015, https://grdc.com.au/resources-and-publications/grdc-update-papers/tab-content/grdc-update-papers/2015/02/diseases-of-pulse-crops-in-2014

9.26.2 How viruses spread

Viruses need aphid vectors to spread from infected to healthy plants. The exception is TSWV, which is transmitted by specific thrip species. Some viruses can be introduced by sowing infected seed. Viruses such as Bean leaf roll virus (BLRV), Beet western yellows virus (BWYV) and, to some extent, Pea seed-borne mosaic (PSbMV) are not seed-transmitted, but can become established after aphid-vector activity.

The most important factors that predispose pulse crops to severe virus infection are:

- Infected seed or close proximity to a substantial virus reservoir (e.g. lucerne, summer weeds).
- A wetter-than-average summer-autumn with green material to allow uncontrolled multiplication of aphids during the time when numbers are usually low. When aphids are present early in the season, epidemics are more likely to occur and the level of damage will be higher.

While field pea seed infected with PSbMV may infect seedlings at a rate of 100%, the rate of transmission for faba bean is thought to be much lower (<1%).

Viruses can be classified by the manner in which they are transmitted by insect vectors: persistent or non-persistent.

Persistent transmission

These viruses are ingested by the insect and are passed to healthy plants through the saliva. It can take more than a day for these insects to become infectious, but the insect will remain infectious for the rest of its life.

Not all aphid species are vectors of this kind of virus in pulses so the identification of aphid species is very important. The main vectors of these viruses are pea, cowpea and green peach aphids. Viruses include BWYV, BLRV and SCSV. Infection will start with random plants and increase as the vectors colonise the crop. Aphids generally only become visible in the crop once they have colonised.

Insecticides that kill aphids can work in suppressing the spread of these types of viruses as transmission rates increase dramatically when the aphids fly.

Non-persistent transmission

Insects transfer these viruses on their mouth parts directly by carrying it from an infected plant to a healthy one. It can only infect one or two more plants at a time.

Many aphid species are vectors of this type of virus, including ones that do not colonise legumes but just land and probe while searching for their preferred hosts (e.g. oat and turnip aphids). Viruses include PSbMV, AMV, CMV and BYMV.

Insecticides are less effective at suppressing these types of viruses as they do not act fast enough. They may make the situation worse as the insecticide can agitate aphids and increase virus spread.

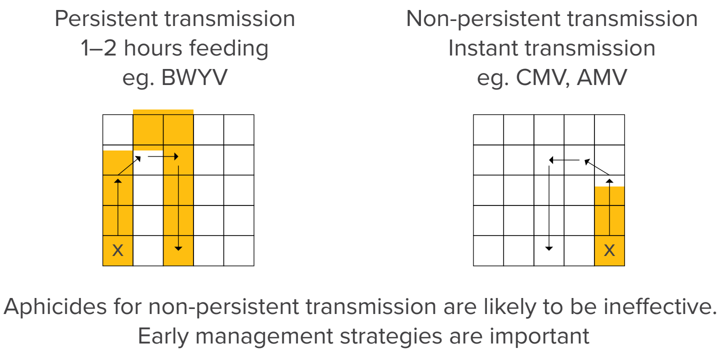


Figure 6: *Differences in the progression of infection within a field of persistent and non-persistent viruses vectored by aphids.*

Source: I SPY manual https://grdc.com.au/i-spy-manual

9.26.3 Symptoms

Initially diseased plants are scattered, but by the time the crop matures, luteoviruses may have infected nearly the entire crop.

Luteoviruses (e.g. BLRV, BWYV and SCRLV) cause yellowing and stiffening of the leaves and sometimes an upwards rolling of the leaf margins. The whole plant will yellow when infected at the seedling stage. When infection occurs later, only the tops of shoots show symptoms – described as 'top yellows'. Infected plants become stunted and die prematurely, unless infection occurs after podding.

BYMV causes leaves to turn pale green. Usually there is a mosaic of dark green patches over the pale green leaves. The leaves develop an uneven surface texture and outline compared with healthy leaves. There is little or no stunting.

CMV infection on faba bean is often symptomless or mild and difficult to observe.

TSWV causes tip necrosis and plant death. Economically significant incidences have been found in the northern region since the introduction of the western flower thrip, a highly efficient TSWV vector in that region. To date it does not appear to be a major problem in the southern region.

Photo 23: *Bean leaf roll virus.*

Photo: Joop Van Leur, NSW DPI via Pulse Australia (2016)

Photo 24: *Bean leaf roll virus.*

Photo: Grain Legume Handbook (2008), https://grdc.com.au/grainlegumehandbook

Photo 25: *Clover yellow vein virus (ClYVV) leaf symptoms and tip necrosis prior to eventual plant death. Symptoms in beans can resemble those of Tomato spotted wilt virus (TSWV), with death of the growing point.*

Photo: SARDI via Pulse Australia (2016), Southern faba & broad bean best management practices training course

Photo 26: *Close up of Tomato spotted wilt virus (TSWV) ring spot lesions.*

Photo: Joop Van Leur, NSW DPI via Pulse Australia (2016), Southern faba & broad bean best management practices training course

Photo 27: *Tomato spotted wilt virus (TSWV) stem and tip necrosis.*

Photo: Joop Van Leur, NSW DPI via Pulse Australia (2016), Southern faba & broad bean best management practices training course

Photo 28: *Tomato spotted wilt virus (TSWV) pod necrosis.*

Photo: Joop Van Leur, NSW DPI via Pulse Australia (2016), Southern faba & broad bean best management practices training course

Photo 29: *Necrosis of the growing tip can be caused by thrip feeding only, not by TSWV.*

Photo: Joop Van Leur, NSW DPI via Pulse Australia (2016), Southern faba & broad bean best management practices training course

Photo 30: *Stem necrosis can result from causes other than TSWV, in this case frost.*

Photo: Joop Van Leur, NSW DPI via Pulse Australia (2016), Southern faba & broad bean best management practices training course

Photo 31: *Leaf symptoms of Bean yellow mosaic virus.*

Photo: Grain Legume Handbook (2008), https://grdc.com.au/grainlegumehandbook

Photo 32: *Pea seed-borne mosaic virus (PSbMV) symptoms in faba bean.*

Photo: Roger Jones, DPIRD via Pulse Australia (2016), Southern faba & broad bean best management practices training course

Photo 33: *Subclover stunt virus (SCSV) in very early sown bean.*

Photo: Wayne Hawthorne, Pulse Australia via Pulse Australia (2016), Southern faba & broad bean best management practices training course

Photo 34: *Soybean dwarf virus (SbDV), also known as subterranean clover red leaf virus (SCRLV).*

Photo: Joop Van Leur, NSW DPI via Pulse Australia (2016), Southern faba & broad bean best management practices training course

9.26.4 Economic importance

Viruses are not considered a major problem of faba and broad bean in the southern region, but should not be ignored (Table 11). Infection can reduce yield and seed quality.[53] (See also Section 3.10 Seed quality.)

Table 11: Incidence and faba bean crop area affected by viruses in the southern region.

Virus**	Incidence* (%)	Area of crop (%)
Beet western yellows virus	6.8	0.3
Broad bean wilt virus	17.0	3.4
Clover yellow vein virus	17.0	0.3
Cucumber mosaic virus	34.1	17.0
Pea seed-borne mosaic virus	6.8	0.3
Soybean dwarf virus	0.0	0.0
Subterranean clover red leaf virus	19.9	2.0
Subterranean clover stunt virus	4.0	0.2
Tomato spotted wilt virus	6.8	0.3

*Incidence as a proportion of years when the disease occurs and area as a percentage of crop area affected when the disease develops.
** No incidence was listed for Alfalfa mosaic virus, Bean leaf roll virus or Bean yellow mosaic virus.

Source: Murray and Brennan (2012), Current and potential costs from diseases of pulse crops in Australia. GRDC Report, https://grdc.com.au/resources-and-publications/all-publications/publications/2012/06/the-current-and-potential-costs-from-diseases-of-pulse-crops-in-australia

53 K Perry, P Mangano, P Umina, A Freeman, R Jones, W Hawthorne, J Davidson (2010) Aphids and viruses in pulse crops Fact Sheet. GRDC, Western and Southern regions, July 2010, http://www.grdc.com.au/GRDC-FS-AphidsandVirusesinPulses

Previous cases of virus damage in southern Australia include:

- The BWYV outbreak in 2014, which damaged canola crops in SA, Victoria and NSW. While there was concern that it could spread to pulse crops including beans, the cold conditions over winter substantially reduced the spread of aphids.[54]
- Seed staining from PSbMV was widely detected in southern Australia in 2013, with severe cases downgraded of quality (Photo 35).[55] It is likely that the source of the virus was nearby infected field pea crops. Nura⁽ᴰ⁾ appeared more prone to expression of symptoms than other faba bean and PBA Rana⁽ᴰ⁾ less prone.
- In 2007 early-sown beans in southern Victoria were substantially damaged by SCSV after the crop emerged into high aphid activity after a wet summer–autumn.
- BLRV had a major impact in parts of South Australia in the drought of 2007. It was first detected in 1993 in northern NSW in faba bean, narbon bean and the forage legume *Lathyrus ochrus*, and by 1995 BLRV had caused major yield losses in faba bean in northern NSW.
- ClYVV caused plant death in spring-sown beans grown adjacent to irrigated white clover in South Australia in the late 1990s. Similar symptoms are seen in faba bean crops on occasion, but can be confused with other causes.

While viruses occur in all states, they are a more of a problem in northern NSW and southern Queensland, occasionally causing total crop failures in chickpea.

Damage caused by the viruses varies greatly from season to season and depends on the prevalence of aphids. Infection is more likely to cause yield loss when infected seed stock is sown, and aphids arrive early in the season. When aphids arrive late other plants can compensate for individual plant losses.

Another luteovirus, SbDV (also known as SCRLV), has been infecting faba bean crops in Australia since the 1970s and does not appear to be a serious problem.

BYMV occurs commonly at a low frequency in faba bean crops and has not caused any serious losses.

Photo 35: *Bean seed showing Pea seed-borne mosaic virus (PSbMV) marking that can affect marketability.*

Source: R. Kimber, SARDI via Pulse Australia (2016), Southern faba & broad bean best management practices training course

54 B Coutts, R Jones, P Umina, J Davidson, G Baker and M Aftab (2015) Beet western yellows virus (synonym: Turnip yellows virus) and green peach aphid in canola. GRDC Updates Paper, 10 February 2015, https://grdc.com.au/resources-and-publications/grdc-update-papers/tab-content/grdc-update-papers/2015/02/beet-western-yellows-virus-synonym-turnip-yellows-virus-and-green-peach-aphid-in-canola

55 J Brand, M Rodda, P Kennedy, M Lines, L McMurray, J Paull and K Hobson (2014) Pulse varieties and agronomy update (Ballarat). GRDC Update Papers, 5 February 2014, https://grdc.com.au/resources-and-publications/grdc-update-papers/tab-content/grdc-update-papers/2014/02/pulse-varieties-and-agronomy-update-ballarat

9.26.5 Disease cycle

Aphids bring the viruses into faba bean crops from surrounding plants, mostly legumes (like lucerne or clovers). Some viruses, like BWYV, AMV, CMV, BYMV and TSWV, have a host range that includes non-legume species. Hence other plant species (e.g. sow thistle, turnip weed) can act as a virus source at the start of the season.

CMV and AMV are non-persistently transmitted by a range of aphid species. *Acyrthosiphum gossypii* is one of many possible vectors of both. The luteoviruses are persistently aphid-transmitted, but are more vector-specific. Correct identification of the aphid is important for effective management.

TSWV is spread by thrips.

Probing and feeding needs to be prolonged for persistently transmitted viruses (0.1–4.0 hours for luteoviruses), but needs be only brief for non-persistently transmitted viruses. Eventually, aphids colonise the bean plant and only then do they become very visible in the crop.

Aphids move between adjacent plants to feed before colonising faba bean plants. Faba bean show a characteristic scattered distribution of patches of virus-infected plants in contrast with a crop like chickpea, where aphids do not colonise and individual plants are infected.

Crop loss depends on the growth stage at infection and the number of plants infected. Early and widespread infections lead to the greatest losses.

Aphid activity is influenced by seasonal conditions and will require early monitoring in nearby crops and pastures. See Section 8 Pest management for more information on monitoring and managing aphids.

9.26.6 Management options

There are no proven methods for controlling viruses. Breeding resistant varieties is the most economical and sustainable way to control viruses.[56] Prevent viruses using integrated management of both the virus and the aphid.

While a large population of aphids is required to inflict feeding damage, virus transmission can occur before aphids are seen to be present. Pre-emptive management is required.

Management options at the planning stage:

- Suppress the virus source within the crop by purchasing virus-tested seed. Only retain seed from crops with no visible symptoms. Grade out smaller grain, which is more likely to be infected. PSbMV, CMV, BYMV and AMV survive through seed transmission. A threshold of 0.1% seed infection is recommended for sowing in high-risk areas, and less than 0.5% for low-risk areas.
- Distance crops from lucerne, weeds or other species that act as a reservoir for viruses, diseases and aphids.
- Control volunteer weeds and self-sown pulses that are a ‘green bridge’ host for viruses and a refuge for aphids and their multiplication during summer and autumn.
- Rotate pulse crops with cereals to reduce virus and vector sources (aphids or other insects) and, where possible, avoid close proximity to perennial pastures (e.g. lucerne) or other crops that host viruses and aphid vectors.

Management options at sowing and in-crop:

- Use a seed treatment of Gaucho® 600 Red Flowable seed treatment insecticide (imidacloprid), which is registered for early aphid protection to control persistently transmitted viruses.

56 J Paull (2011) UA00097 Australian Faba Bean Breeding Program 2007-2011. Project Final Report, University of Adelaide, https://grdc.com.au/research/reports/report?id=1485

- Retain cereal stubble as aphids are less likely to land in stubble.
- Sow at recommended times to avoid autumn aphid flights.
- Sow at recommended plant densities to achieve early closure of the crop canopy. Closed canopies deter aphids.
- Note that high seeding rates and narrow row spacing to provide early canopy closure assists in aphid control, but conflicts with management of fungal diseases.
- Manage crops to minimise seedling stress through disease, herbicide damage and poor nutrition. Stressed crops are more attractive to aphids.
- Insecticides after emergence may be effective for persistently transmitted viruses. However, they may not be effective for non-persistently transmitted viruses as the insecticide can agitate aphids and increase virus spread.
- Monitor faba bean and nearby crops and pastures for aphids. Be prepared to use insecticide when there may be localised flights.

Insecticide resistance is becoming more common in aphids. Growers should only consider applying insecticide for virus control if they consider their crops to be at high risk. Insecticides aimed at controlling damage from aphid feeding are normally too late to control virus spread and damage.

FEEDBACK

MORE INFORMATION

The Agriculture Victoria webpage has information on seed health testing in pulse crops http://agriculture.vic.gov.au/agriculture/pests-diseases-and-weeds/plant-diseases/grains-pulses-and-cereals/seed-health-testing-in-pulse-crops

The DPIRD webpage has details on seed testing at: https://www.agric.wa.gov.au/plant-biosecurity/ddls-seed-testing-and-certification-services

The TASAG webpage has testing details at: http://dpipwe.tas.gov.au/biosecurity-tasmania/plant-biosecurity/plant-health-laboratories/tasag-elisa-testing

The Agrifood Technology webpage has information on food safety at: http://www.agrifood.com.au/index.php/services/food-safety

9.26.7 Virus testing

Diagnostic testing is available for plant viruses. Only some tests can be performed with relative ease in the field. Current testing options may not detect the less common viruses.

Detection of virus in 1 or 2 plants is not proof that the virus is causing a problem. It is important to check for a range of viruses, as the one detected by a test may not be the virus actually causing symptoms.

Detection of a seed-borne virus does not mean there will be virus present in progeny seed. Seed samples from the crop require testing to determine if seed infection has occurred.

Serological testing for viruses is available through DDLS Seed Testing and Certification (formerly AGWEST Plant Laboratories), TASAG ELISA and pathogen testing service or Agrifood Technology.

TASAG also sell Agdia Immunostrips test kits. A result can be obtained in minutes. (Also see Section 3.11 Seed testing).

DPIRD Diagnostic Laboratory Services (DDLS) Seed Testing and Certification

DDLS conduct seed tests for CMV.

Department of Primary Industries and Regional Development
Reply Paid 83377
3 Baron Hay Court
South Perth, WA 6151
Ph: 08 9368 3721

Email: DDLS-STAC@agric.wa.gov.au

https://www.agric.wa.gov.au/plant-biosecurity/ddls-seed-testing-and-certification-services

TASAG

TASAG offer in-house virus testing of plants or seed and test kits that can be used in the field (Agdia Immunostrips test kits, US website www.agdia.com).

Contact: Peter Cross
New Town Laboratories
13 St John's Ave
New Town, Tasmania, 7008
Ph: 03 6165 3252
Email: peter.cross@dpipwe.tas.gov.au
http://dpipwe.tas.gov.au/biosecurity-tasmania/plant-biosecurity/plant-health-laboratories/tasag-elisa-testing

Agrifood Technology

Agrifood conduct testing for CMV and AMV.

Contact: Robert Rantino or Doreen Fernandez
260 Princes Highway, Werribee, VIC 3030, Australia
Postal: PO Box 728, Werribee, VIC 3030, Australia
Phone: 1800 801 312
http://www.agrifood.com.au/index.php/services/food-safety

9.27 Exotic diseases with potential to impact on Australian crops

If you suspect an exotic disease immediately contact Plant Health Australia's **Exotic Plant Pest Hotline** on **1800 084 881**.

9.27.1 Downy mildew (*Peronospora viciae*-fabae)

Downy mildew is considered the major exotic disease risk for faba bean. It is host-specific, but symptoms are similar to the closely related downy mildew of peas (*Peronospora viciae*).[57]

Systemic, localised and pod infections can all occur in faba and broad bean. Young plants can develop symptoms, but generally symptoms become obvious at a later stage, with the leaves developing the characteristic pale patches on the surface, and grey-mauve fluffy mycelium on the undersides. Red-brown flecks can develop on the lesions and occasionally the edges of the lesions become discoloured (Photo 36).

Plants that are infected systemically show stunting and distortion, and are pale green in colour (Photo 37). In cool, wet or humid weather, infected leaves develop characteristic greyish-fawn mycelium with spores visible. Often sporulation is confined to those leaves at the apex of the plant. Localised infections produce light green to pale brown or yellow irregular patches or more regular circles on the upper leaf surface. Sporulation occurs on the corresponding underside of the leaf, showing greyish fluffy growth. Infected material quickly becomes reddish-brown and necrotic.

Plants that are systemically infected from soil-borne inoculum are pale and stunted and may be scattered among the crop. Secondary infection symptoms are distinctive, with the fluffy fungal growth on the undersides of leaves being a specific symptom of downy mildew.

As symptoms are perhaps characteristic of a number of seedling and leaf diseases or disorders of faba and broad bean, plant samples showing suspected 'mildew-like' symptoms, reddening, wilting and/or yellowing should be sent for diagnosis.

Entry would be through debris or soil contamination. Severe infections can have a dramatic effect on yield.

Photo 36: *Typical 'mildew-like' symptoms on a faba bean plant affected by downy mildew.*

Photo: SARDI via Pulse Australia (2016) Southern faba & broad bean best management practices training course

57 Pulse Australia (2016) Southern faba & broad bean best management practices training course – 2016. Pulse Australia.

Photo 37: *Bean plant systemically infected by downy mildew.*

Photo: NIAB via Pulse Australia (2016) Southern faba & broad bean best management training practices training course

9.27.2 Fusarium wilt (*Fusarium avenaceum* f. sp. *fabae* and *F. oxysporum* f. sp. *fabae*)

The primary host is faba bean. Fusarium wilt affects stems, roots, growing points, inflorescence and seeds. Seedling wilt is characterised by sudden drooping and drying of leaves and whole seedling. Adult symptoms appear at flowering to late pod-fill, with sudden drooping of top leaflets, leaflet closure without premature shedding, and dull green foliage followed by wilting of whole plant or individual branches. Root systems will appear normal, with a slight reduction in lateral roots.[58]

The pathogen has a low entry potential but high establishment and spread potential. It is viable in soil and debris for up to 3 years and in spores spread by mechanical means and on seed.

This is the most destructive disease of faba bean in China.

9.27.3 Red clover vein mosaic virus (carlavirus)

Red clover vein virus (RCVV) is polyphagous with numerous legume hosts. It affects the whole plant in the vegetative phase and is seed-borne. Generally, it causes vein mosaic, mosaic, streaking and stunting in various legumes. Faba bean may have chlorotic lesions, or general chlorosis, tip mottle and abscission.[59]

There is high entry potential via seed. It has high establishment and spread potential with four of seven known vectors present in Australia.

58 Pulse Australia (2016) Southern faba & broad bean best management practices training course – 2016. Pulse Australia.

59 Pulse Australia (2016) Southern faba & broad bean best management practices training course – 2016. Pulse Australia.