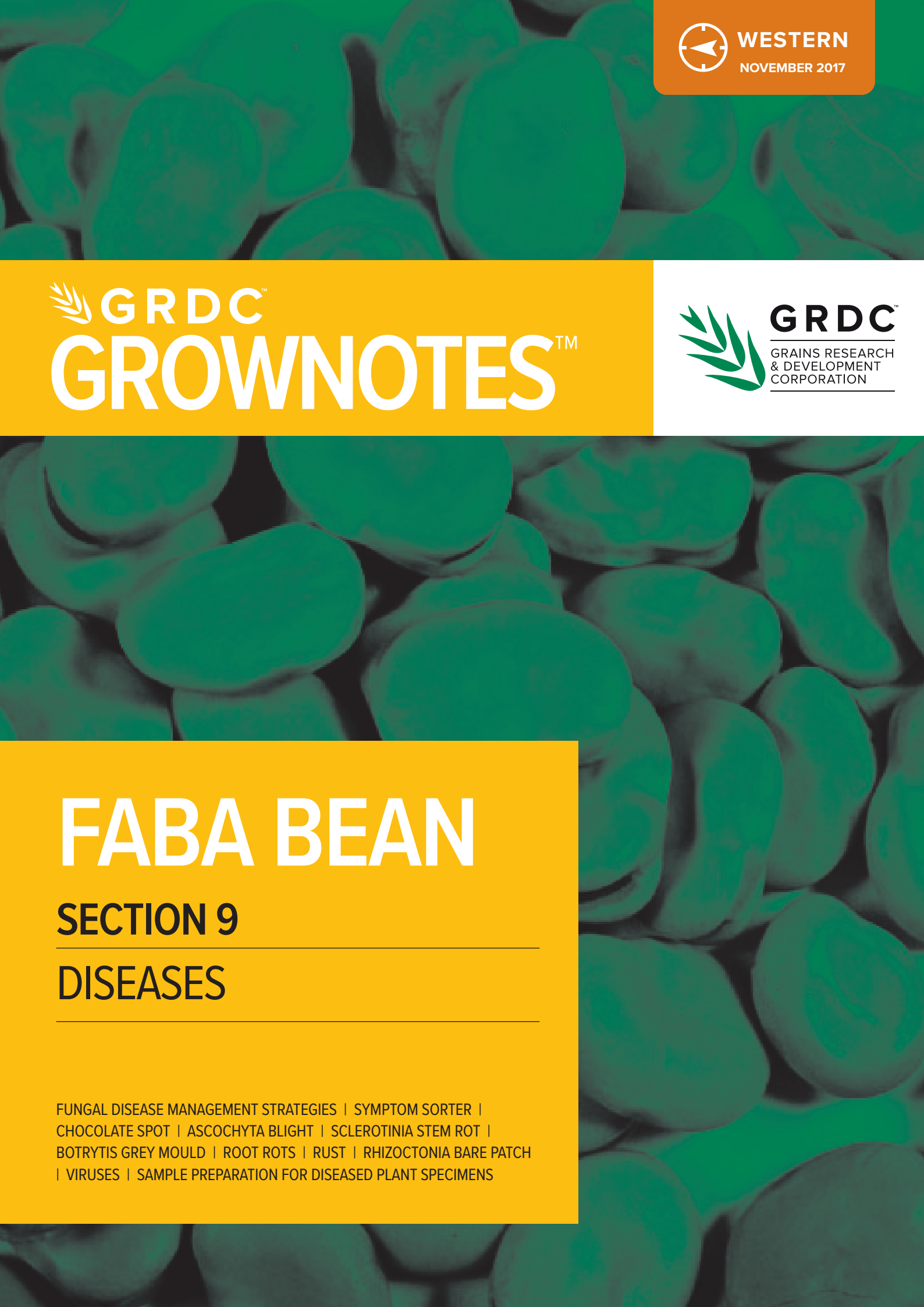

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GRDC GROWNOTES™

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GRAINS RESEARCH & DEVELOPMENT CORPORATION

FABA BEAN

SECTION 9

DISEASES

FUNGAL DISEASE MANAGEMENT STRATEGIES | SYMPTOM SORTER | CHOCOLATE SPOT | ASCOCHYTA BLIGHT | SCLEROTINIA STEM ROT | BOTRYTIS GREY MOULD | ROOT ROTS | RUST | RHIZOCTONIA BARE PATCH | VIRUSES | SAMPLE PREPARATION FOR DISEASED PLANT SPECIMENS

Diseases

Key messages

- Chocolate spot (*Botrytis fabae*) can cause extensive losses and is the major disease of faba beans in WA.
- In central and southern areas of WA use varieties that are at least moderately resistant to Ascochyta blight such as Fiesta VF.
- Rhizoctonia bare patch (*Rhizoctonia solani*) occurs on most soil types in the WA wheatbelt.
- Ascochyta blight occurs in all faba bean growing areas of Western Australia.
- The weather is the principal factor in translating disease risk into disease severity.
- Managing foliar disease in faba beans is all about reducing the risk of infection.

9.1 Fungal disease management strategies

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

The impact of disease on grain quality in pulses can be far greater than yield loss. This must be accounted for in thresholds because in pulses, visual quality has a significant impact on market price.

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 points in disease development, and all can be represented by the classical disease triangle (Figures 1 and 2). Diseases such as Ascochyta blight and Phytophthora root rot can cause total crop failures very quickly, whereas Botrytis grey mould and root-lesion nematodes may 'tick' away over the season and mask their true effects on crop performance and yield. [1]

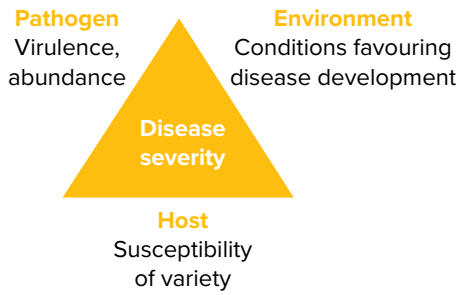


Figure 1: *The fungal-disease triangle.*

Source: Agrios 1988

1 Pulse Breeding Australia (2013) Southern/Western Faba and Broad Bean—Best Management Practices Training Course. Module 6—Disease Management.

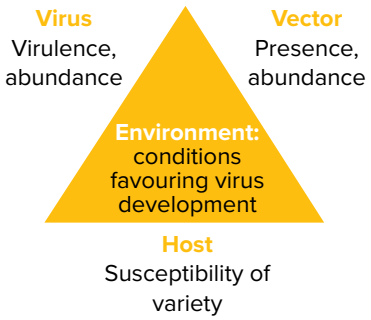


Figure 2: *The virus-disease triangle, which also applies to some bacteria.*

Source: Jones 2012

Disease management should be a consideration when planning any rotation, particularly at the beginning of the season. This is especially important for faba beans where the first action of defence against diseases begins with paddock selection. Other criteria such as seed quality and treatment are also vitally important.

Determine which diseases are the highest priorities to control in the pulse crop being grown, and if possible sow a variety that is resistant to those diseases. Strategic fungicide application combined with paddock selection is also part of an overall program to minimise the impact of disease. Fungicide disease-control strategies alone may not be economic in high-risk situations, particularly if susceptible varieties are grown.

Variety selection

Growing a resistant variety reduces the risk and reliance on foliar fungicides.

In practical terms, under average conditions for disease development, no economic yield loss is expected in resistant varieties, and control measures are unlikely to make the crop more profitable. Resistance does not mean immunity though:

- Varieties with a disease description of moderately resistant are expected to sustain low to moderate yield loss and control measures are likely to be cost-effective.
- Varieties with a disease description of moderately resistant to moderately susceptible are expected to sustain moderate to high losses and control measures are necessary to ensure a profitable crop.
- Varieties with disease description of moderately susceptible or worse will sustain very high to total yield loss and control measures are essential to produce a harvestable crop.

Pulse varieties are now rated for Ascochyta blight on both foliage and on pods and seeds because there are differences in their susceptibility and resistance. This may influence control strategies and timings during podding so as to preserve seed quality, and hence marketability. [2]

2 Pulse Breeding Australia (2013) Southern/Western Faba and Broad Bean—Best Management Practices Training Course. Module 6—Disease Management.

Table 1: *Faba bean variety ratings for the common bean diseases in Australia.*

Variety	Ascochyta blight		Chocolate spot	Rust	Cercospora spot	PSbMV Seed staining
	Foliage	Seed				
Ascot VF	R	R	VS	S	S	–
Aquadulce	MS	MS	MS	MS	S	MS
Cairo(ɒ)	VS	VS	VS	MS	–	–
Doza(ɒ)	VS	VS	MS	MR-R	S	–
Farah(ɒ)	MR-R	MR-R	S	S	S	S
Fiesta VF(ɒ)	MS-MR	MS	S	S	S	S
Fiord(ɒ)	MS	MS	VS	S	S	S
Icarus	VS	VS	MR	MR	–	–
Manafest	VS	VS	MS	MS	–	–
Nura(ɒ)	MR-R	MR-R	S	MS	S	VS
PBA Kareema(ɒ)	MR-R	MR-R	MS	MS-MR	S	
PBA Samira(ɒ)	R	R	MS	MS	S	S
PBA Rana(ɒ)	R	R	MS	MS-MR	S	MR-R
PBA Warda(ɒ)	S	S	MS	MR-R	S	–

VS, very susceptible; S, susceptible; MS, moderately susceptible; MR, moderately resistant; R, resistant

Source: Pulse Australia

Distance

Proximity to stubble of the same pulse from the previous year will affect the amount of infection for some diseases. Aim for a separation distance of at least 500 m.

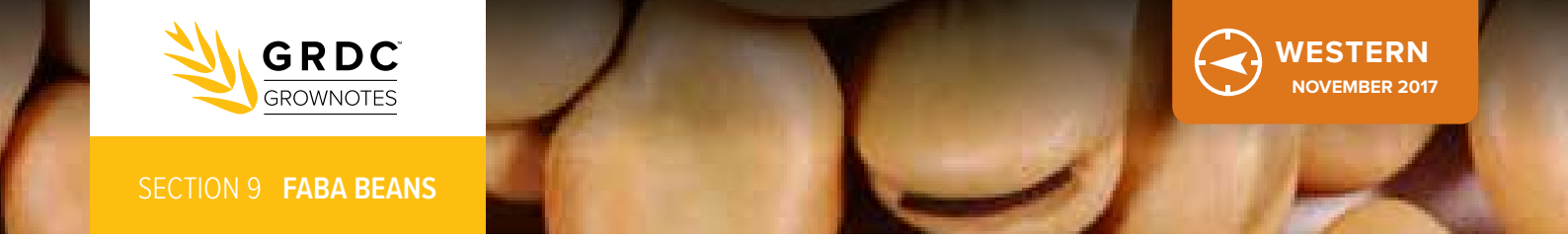
Paddock history and rotation

Aim for a break of at least four years between planting the same pulse crop. A high frequency of crops such as faba beans, lentils, vetch, field peas, chickpeas, *Lathyrus* species, or clover pasture puts pulses at greater risk of multi-host fungal pathogens such as *Phoma*, *Sclerotinia* and *Botrytis* species. Ascochyta blight species are more specific to each pulse crop but three to four year rotations are still important. Canola can also increase the risk of Sclerotinia rot.

Paddock selection

The selection of the most appropriate paddock for growing faba beans requires consideration of a number of important factors, many of which are related to the modes of survival and transmission of pathogens such as *Ascochyta fabae*.

- Rotation
  - » Develop a rotation of no more than one year of faba beans in four years.
  - » Plant faba 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 (aphids may be vectors for viruses).
  - » Consider previous crops that may have hosted pathogens such as *Sclerotinia* spp., *Rhizoctonia* solani. and *Phoma medicaginis*.
  - » *Ascochyta fabae* and *Botrytis fabae* are faba bean specific, whereas *Botrytis cinerea* has a wide host range including lentil and weeds such as *Euphorbia* spp., groundsel and emu-foot.
- History of faba bean diseases



- » A previous occurrence of soil-borne diseases (Sclerotinia stem rot, Stem nematode or *Pratylenchus* nematodes) constitutes a risk for subsequent faba bean crops for up to 10 years.
- » Plant at least 500 m (preferably more) away from the previous year's faba bean crop.

- Weeds
  - » Nearly all weeds host *Sclerotinia* spp.
  - » 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, CMV).
- Herbicide history
  - » Determine whether triazine, 'imi' or sulfonylurea herbicides been applied in the last 12 months
  - » The development of some diseases is favoured in herbicide-weakened plants.
  - » The presence of herbicide residues in the soil may cause crop damage and thus confusion over in-field disease diagnosis. [3]

Hygiene

Take all necessary precautions to prevent the spread of disease. Reduce last year's pulse stubble if erosion is not a risk, and remove self-sown pulses before the new crop emerges.

Control of volunteer faba beans during summer–autumn and in fallows is vital to avoid the carryover of inoculum of chocolate spot, rust and Ascochyta blight pathogens. Some broadleaf weeds are alternative hosts of one or more of the viruses that affect faba beans, and of *Sclerotinia* species, and should be killed before planting and while the crop is growing.

Pathogens such as *Ascochyta fabae* can also be transmitted via infected stubble and soil. Soil and stubble movement may occur by machinery, during windy and/or wet weather, and by flooding. Therefore, it is essential all headers and sowing equipment be thoroughly cleaned to remove grain, soil and stubble before moving from property to property, and if possible in particularly high-risk disease situations, between paddocks.

Spray rigs should also be cleaned to reduce the risk of transmitting diseases, particularly if contractors are used.

Paddock inspections should be carried out using clothing suitable to the task and, ideally, footwear should be disinfected before entering a crop. [4]

Seed quality and dressings

Use seed from crops where there was no disease or low levels of disease, especially at podding. Avoid sowing seed that is known to have disease infection, particularly of the susceptible varieties. Have seed tested for disease status where recommended.

Use only seed of high quality (in purity, germination and vigour). Source seed from a paddock where diseases, particularly those that affect pods, have not been detected. In particular, seed from a crop known to have been heavily affected by Ascochyta blight should not be used.

Treatment of seed with a fungicide dressing is an option, but not essential; it controls seed-borne Ascochyta blight and Botrytis grey mould (BGM), and several soil-borne fungal diseases (Table 2). [5]

3 Pulse Breeding Australia (2013) Southern/Western Faba and Broad Bean—Best Management Practices Training Course. Module 6—Disease Management.

4 Pulse Breeding Australia (2013) Southern/Western Faba and Broad Bean—Best Management Practices Training Course. Module 6—Disease Management.

5 Pulse Breeding Australia (2013) Southern/Western Faba and Broad Bean—Best Management Practices Training Course. Module 6—Disease Management.

Table 2: *Seed dressings registered for use with faba beans (but not often used).*

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

R, claim on registered product label; NR, not registered for use in this crop.
Refer to the current product label for complete directions for use before applying product.

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 beans.

Registered labels and current permits can be found on the website of the Australian Pesticide and Veterinary Medicine Authority (APVMA).

Seed dressings are partially effective early, particularly for diseases such as seed-borne Botrytis grey mould, Phoma blight and Ascochyta blight. They are not effective on viruses and bacterial diseases.

Sowing date

To minimise the risk of foliar disease, do not sow too early. This will help 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 species and your region.

Sowing rate

Aim for the optimum plant population for the region, sowing time, crop type, and 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 usual will help reduce the emergence of infected seedlings. The seeding rate must be adjusted upwards to account for the likelihood of fewer seedlings emerging and establishing.

Foliar fungicide applications

Disease-resistant varieties do not require the intense, regular application of foliar fungicides that susceptible varieties need to control foliar diseases. Some pulses may require fungicide treatment for Botrytis grey mould (BGM) if a dense canopy exists. Successful disease control with fungicides is dependent on the timeliness of spraying, the 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.

Foliar fungicides are essential for the management of Ascochyta blight in all varieties, and are an important tool for the management of BGM. Varieties with higher levels of Ascochyta blight resistance do not require as many sprays as susceptible varieties. The success of foliar fungicides depends on timeliness of spraying (hence the importance of regular crop monitoring), appropriate fungicide selection, and correct application. Early detection and fungicide application is vital.

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 beans. *Check current registrations* on the APVMA website. Registered labels and current permits can be found on this site. [6]

A fungicide sprayed at the commencement of flowering protects early podset. Additional protection may be needed until the end of flowering in longer growing seasons. Fungicides last around two to three weeks.

In periods of rapid growth and intense rain (50 mm over several days), the protection period will reduce to ~10 days. All new growth after spraying is unprotected.

The need for and timing of repeat fungicide sprays depends on:

- the amount of unprotected growth
- rainfall after spraying
- the likelihood of a further extended rainy period [7]

Mechanical damage

Any physical damage due to excessive traffic, wind erosion, frost, hail, post-emergent rolling or herbicide damage can lead to the increased spread of foliar disease in pulses.

Controlling aphids

Controlling aphids may reduce the spread of viruses, but will not eliminate them. Protective insecticide treatments are unlikely to be successful if applied strategically, or economic if applied regularly. Usually the virus has spread by the time the aphids are detected.

Harvest management

Early harvest will help reduce the infection of seed, and is also important for grain quality and to minimise harvest losses. Crop desiccation enables an earlier harvest, reduces moisture risk and adverse weather risks. Moisture contents of up to 14% are allowable at delivery. Do not desiccate before physiological maturity as this can affect grain quality. [8]

9.1.1 Risk assessment

Risk assessment is the prediction of likely damage from a faba bean disease. It can be used at the paddock, farm, regional, state or national level. The choice of variety, disease management options and fungicide availability are some of the factors used to determine risk. Seasonal conditions and sowing times have a huge impact on risk as well.

The distribution and dispersal (large-scale spatial patterns) of a pathogen contribute to the regional occurrence of a disease. This regional pattern was evident in the chocolate spot epidemics in different states in the early years of faba bean production using the variety Fiord(). See Tables 3 and 4.

Increased distance of new crop from inoculum on infested stubble and old crop volunteers meant the limited pressure of the fungus in these areas had less impact than in the more intensive systems.

The risk of severe faba bean diseases is also intimately linked with weather conditions, i.e. rainfall, humidity and temperature.

Modelling pulse disease, including those of faba beans, in Australia is in its infancy. However, we do have a good understanding of the epidemiology of the predominant diseases and their close association with weather conditions. Hence, fungicide

MORE INFORMATION

Pulse Australia (2016) Faba Bean Fungicide Guide: 2016 Season

G M Murray and J P Brennan (2012) The current and potential costs from diseases in pulse crops in Australia. GRDC.

6 Pulse Breeding Australia (2013) Southern/Western Faba and Broad Bean—Best Management Practices Training Course. Module 6—Disease Management.

7 Pulse Breeding Australia (2013) Southern/Western Faba and Broad Bean—Best Management Practices Training Course. Module 6—Disease Management.

8 Pulse Breeding Australia (2013) Southern/Western Faba and Broad Bean—Best Management Practices Training Course. Module 6—Disease Management.

protection applied before rainfall events is an integral part of an overall disease-management strategy. [9]

Table 3: *Carryover of major faba bean diseases showing their relative importance as sources of infection.*

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

Table 4: *Diseases occurring on pulses with potential for cross-infection.*

	Chickpea	Faba beans	Lentils	Lupins	Peas	Vetch
Botrytis grey mould						
Botrytis cinerea	★★	★★	★★	★	★★	★★
Chocolate spot						
Botrytis fabae	★	★★	★★			★★
Cercospora leaf spot						
Cercospora zonta		★★				
Sclerotinia disease						
Sclerotinia sclerotiorium	★★		★★	★★	★★	
Sclerotinia trifoliorium	★★	★★		★★		
Bacterial blight						
Pseudomonas andropogonis	★					
Pseudomonas syringae pvv. *syringae*		★★	★		★★	
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* and *Ascochyta*)						
Mycosphaerella pinodes	★★	★	★		★★	★
Anthracnose						
Colletotrichum gloeosporioides				★★		
Brown leaf spot						
Pleiochaeta setosa				★★		
Grey leaf spot						

9 Pulse Breeding Australia (2013) Southern/Western Faba and Broad Bean—Best Management Practices Training Course. Module 6—Disease Management.

	Chickpea	Faba beans	Lentils	Lupins	Peas	Vetch
Stemphylium botryosum	★		★★	★★		
Downy mildew						
Peronospora viciae					★★	★
Powdery mildew						
Erysiphe polygoni					★★	
Septoria leaf spot						
Septoria pisi					★★	
Phomopsis disease						
Phomopsis leptostromiformis				★★		
Rust						
Uromyces viciae-fabae[A]		★★			★	★★
Root-lesion nematode						
Pratylenchus neglectus	★					
Pratylenchus thornei	★★	★★				★★
Stem nematode						
Ditylenchus dipsaci	★	★★			★★	★
Viruses						
Bean yellow mosaic virus		★		★★		
Cucumber mosaic virus	★	★	★★	★★		
Luteoviruses complex (e.g. Bean leaf roll virus and Bean western yellows virus)	★★	★★	★		★★	★★
Tomato spotted wilt virus hosted by lupins can cause cross infection in faba beans				★		
Pea seedborne mosaic virus					★★	
Alfalfa mosaic virus	★★	★	★★			★
Wilt						
Fusarium oxysporum[A]				★★	★★	
Root rots						
Fusarium	★	★	★	★	★	★
Macrophomina	★				★★	
Phytophthora medicaginis	★★					
Pleiochaeta setosa			★★			
Pythium [B]	★		★	★	★	
Rhizoctonia	★	★★	★★	★★	★★	★★
Sclerotinia [C]	★		★	★	★	

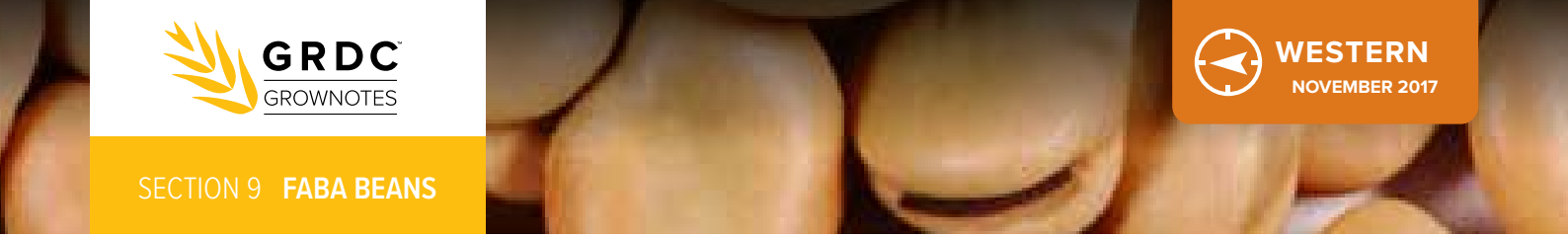
★ Disease occurs in this crop but does not caused major damage; ★★ Disease has caused major damage to this crop

A Strain differences between crops.

B Pythium and Botrytis grey mould is worse (★★★) in white peas than dun peas (★★)

C Sclerotinia (root rot) is worse (★★) in Kabuli than Desi (★). [10]

10 Pulse Breeding Australia (2013) Southern/Western Faba and Broad Bean—Best Management Practices Training Course. Module 6—Disease Management.



9.1.2 Regular crop monitoring

The main diseases where monitoring is necessary are chocolate spot (caused by *Botrytis fabae*) and Ascochyta blight (*Ascochyta fabae*). By following the monitoring process recommended for these diseases, farmers have the opportunity to assess the impact or presence of 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.

Chocolate spot

Chocolate spot is more likely to occur in bulky crops where the canopy closes. The critical stage for the first inspection will be just before flowering commences, as temperatures begin to increase, and then regularly through the flowering and seed-filling period. Lesions occur on leaves and flowers first, and can also occur on stems and pods. Flower abortion and drop can occur.

The first symptoms are small brown spots on leaves and flowers. They rapidly develop into large, irregular-shaped lesions on leaves and into the decay of flowers, when conditions remain favourable for the disease.

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

See Section 9.9 Diseases.

Ascochyta blight

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

Monitoring should commence two to three weeks after emergence, or 10–14 days after rain. This is to allow time for the disease to develop after the occurrence of an infection, such as transmission from infected seed or rain-splashed inoculum. Infected seedlings may deteriorate quickly and plant parts above the lesion may break off, making symptoms difficult to detect.

Timing is critical. After the initial inspection, subsequent inspections should occur every 10–14 days after rain or heavy dew. During dry periods, inspections can be less frequent. Look for signs of lesions on the leaves, or wilting in upper foliage or small areas of dead or dying plants (which indicate a severe infection). If any of these signs are present, examine individual affected plants for symptoms of infection. [11]

See Section 9.9 Diseases

11 Pulse Breeding Australia (2013) Southern/Western Faba and Broad Bean—Best Management Practices Training Course. Module 6—Disease Management.

Table 5: *Faba bean diseases and fungicide control options throughout a season.*

Critical period	Disease		Fungicide*	Comments
	Target	Secondary		
First critical period Early vegetative (5–8 weeks after emergence)	Ascochyta blight	–	Mancozeb or chlorothalonil	Early fungicide application is critical to restrict early development and spread of disease. 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. Cercospora spot is often first disease to appear. Early chocolate spot control can be important in early sown crops. Cercospora leaf spot occurs 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 Rust could be an early target in early sown crops as well. Use the lower rate on crops <20 cm in height. Use the higher rate for dense crops or if disease pressure is severe.
	Cercospora leaf spot	–	Tebuconazole or carbendazim	
	Cercospora leaf spot plus	Chocolate spot	Tebuconazole + mancozeb or use carbendazim	
	Ascochyta blight plus	Cercospora spot	Tebuconazole + Mancozeb or carbendazim + Mancozeb, or chlorothalonil by itself	
	Cercospora leaf spot plus	Ascochyta blight	Either tebuconazole or carbendazim + either Mancozeb or chlorothalonil	
	Rust plus	Chocolate spot	Mancozeb or chlorothalonil	
Second critical period Pre canopy closure, during flowering (13–16 weeks after emergence through flowering)	Ascochyta blight plus	Chocolate spot	Mancozeb or chlorothalonil	Early-mid-flowering protection before the disease establishes is recommended: before canopy closure. Protection of flowers to assist pod set is important. Chocolate spot occurs 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 If Ascochyta blight is detected, and/or chocolate spot appears in the upper third of the crop canopy, and rain or high humidity are likely, then apply fungicide if crop has sufficient yield potential.
	Chocolate spot plus	Ascochyta blight	Either carbendazim or procymidone + either Mancozeb or chlorothalonil	
	Chocolate spot plus	Cercospora	Carbendazim or chlorothalonil or procymidone + tebuconazole	
	Severe chocolate spot	–	Procymidone	

Critical period	Disease		Fungicide*	Comments
	Target	Secondary		
Third critical period Late flowering to end of flowering when pods are filling (15–20 weeks after emergence)	Ascochyta blight &/or rust plus	Chocolate spot	Mancozeb or chlorothalonil	If Ascochyta is detected, rain is likely or new spots of chocolate spot appear or are likely to appear on unprotected leaves on the upper third of the plant, then apply or re-apply fungicide if the crop has sufficient yield potential. Rust occurs during flowering or pod filling. Observe all withholding periods.
	Chocolate spot plus	Ascochyta blight &/or rust	Either carbendazim or procymidone + either Mancozeb or chlorothalonil	
	Chocolate spot	–	Carbendazim or procymidone	

Note that metiram is considered comparable to mancozeb and can be substituted for it.

9.2 Symptom sorter

Faba bean diseases can present in a similar manner, for instance the symptoms of chocolate leaf spot, cercospora leaf spot and Ascochyta are similar. Without correct identification incorrect management strategies can be used. Tables 7 and 8 can be used to help diagnose diseases from other crop-damaging causes in faba beans.

Table 6: *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 and leaf spotting	Red-legged earth mite, chocolate spot
	Yellow/red	Stunted	Root rots, dodder
		Premature death	Root and crown rot
	Pale green	Leaf and 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/rabbit 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

Description	Crop effect	Plant symptoms	Disorder
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, Cercospora leaf spot, Alternaria leaf spot, hail
	Physically damaged	Leaf, stem & pods damaged	Triazine herbicide
	None obvious	Pods chewed	Native budworm
		Pod spotting	Oedema

Source: Faba Beans: The Ute Guide

Table 7: *Key features of the main faba bean diseases and disorders.* [12]

Disorder and cause	Seed-borne?	Symptoms	Distribution and occurrence	Survival and spread	Management
Waterlogging or root rotting (root anoxia—not a disease)	No	Slow death; little defoliation; roots not rotted but may be dark; plants hard to pull up	Patches; poorly drained areas; heavy rainfall; higher temperatures, i.e. later in season	Caused by insufficient supply of oxygen to roots	Avoid low lying or poorly drained paddocks or areas within paddocks. Sow in raised beds
Seed-borne root rot *Botrytis cinerea*, *Botrytis fabae* *Ascochyta fabae* (very rare)	Yes	Seedlings wilt and die, epicotyl rots	Rare, as seedling wilting and death is not common to either *Botrytis* or *Ascochyta* in beans. Occurs in random individual plants (not patches)	Seed	Quality seed; seed treatment, variety choice
Chocolate spot *Botrytis fabae* Including: Botrytis grey mould *Botrytis cinerea*	Yes/no	Leaf, flower, stem and pod lesions and rapid tissue death. Possibly lesions covered in mould	Occurs from late winter–early spring when canopy closes and warm humid conditions persist; individual plants but spread quickly to patches	Can be seed-borne, but mostly pathogen has airborne spores which can blow in	Sow a variety with best resistance available. Avoid highly susceptible varieties; use a foliar spray program; plant on wider rows; follow faba bean chocolate spot management package
Sclerotinia root and stem rot *Sclerotinia* spp.	Only as sclerotia in seed	Wilting and death; bleached root, collar and stem tissue; white cottony mould at site of lesion; sclerotia at lesions or inside stems	Root and collar lesions result from direct infection from sclerotia; stem lesions result from air-borne ascospores released from sclerotial apothecia, scattered or patches; favoured by denser canopies, wet events	Sclerotia persist in soil for many years; wide host range including pulses, canola, sunflowers and broadleaf weeds but not cereals or grasses	Sow seed that is clean of sclerotia. Avoid paddocks with history of *Sclerotinia* of its hosts; rotate with cereals; some varieties more susceptible

12 Pulse Breeding Australia (2013) Southern/Western Faba & Broad Bean—Best Management Practices Training Course. Module 6—Disease Management.

Disorder and cause	Seed-borne?	Symptoms	Distribution and occurrence	Survival and spread	Management
Rhizoctonia rot *Rhizoctonia solani*	No	Death of seedlings, stunting of survivors due to root damage, re-shooting after damping off of epicotyl	Can be a problem in irrigated crops grown immediately after cotton. Often occurs in 1–5m stretches of row	Survives in soil and on decomposing trash. Probably present in most soils	Allow time for decomposition of (preceding) crop debris. Tillage should help
Ascochyta blight *Ascochyta fabae*	Yes	Necrotic spotting on all plant parts; lesions with visible fruiting structures (pycnidia); stem lesions; plant death	Individual plants which can spread to small patches, which enlarge rapidly in after rain events to severely damage leaf, stem and pods, possibly killing areas of susceptible crops	Faba bean residue very important in spread especially header dust and surface water flow; infected seed; volunteers	Follow faba bean *Ascochyta* management package, which includes variety choice and foliar fungicides
Cercospora leaf spot *Cercospora zonata*	No	Small dark grey–black lesions on lower leaves early in the season. Change to brown/red as expand and can merge to large lesions. Defoliation in lower canopy at flowering	Scattered plants on infested soil, linked to faba bean history in paddock	Survives in soil and infested faba bean residue	Follow faba bean cercospora leaf spot management package published annually; includes foliar fungicides
Rust *Uromyces viciae-fabae*	No	Leaf, stem and pod pustules develop leading to tissue death	Occurs very early in early sown crops, but normally late in season when warm humid conditions persist; Most plants affected, but possibly in patches. Often in association with chocolate spot	Faba bean residue and self-sown seedlings very important in spread. Airborne spores can blow around	Avoid highly susceptible varieties; use foliar fungicide program; follow faba bean rust–*Ascochyta* management package
Root-lesion nematodes *Pratylenchus* spp	No	Often showing no symptoms. If severe, possibly poor growth; small black lesions on lateral roots sometimes visible	Can affect large areas of crop. *P. thornei* more prevalent on high clay content soils	Wide host range; survives & spreads in soil; anhydrobiosis allows nematodes to persist for prolonged dry periods	Farm hygiene; rotate species (faba bean is one); grow tolerant varieties
Stem nematode *Ditylenchus dipsaci*	Yes/no	Poor emergence and establishment, stunting and distortion of seedlings, swollen stem bases	Symptoms usually occur in patches, but the large sections of a crop can be affected in severe cases	Wide host range; survives and spreads in soil and plant residue	Farm hygiene; rotate species

Disorder and cause	Seed-borne?	Symptoms	Distribution and occurrence	Survival and spread	Management
Alfalfa mosaic virus Cucumber mosaic virus	Not in faba beans, but is in other pulses	Not necessarily an issue in faba beans. In other crops is initially bunching, reddening or yellowing, wilting or death of shoot tips; later discoloration	Initially scattered plants or patches, often at edges of crop; more common in thin stands and areas	Viruses persist and multiply in weeds and pasture legumes; aphid-borne	Establish uniform stand by using recommended sowing rates and times; sowing into standing stubble
Phloem-limited viruses (luteoviruses): Bean leaf roll virus Subterranean clover redleaf virus Beet western yellows virus Subterranean clover stunt virus	No	Death of entire plant; luteovirus-infected plants often have discoloured phloem	Close to lucerne, irrigated perennial clovers; seasons or districts with major aphid flights		Cereal stubble deters aphids; avoid sowing too early; grow resistant varieties

FAQ

9.3 Chocolate spot

9.3.1 Symptoms

Chocolate spot (*Botrytis fabae*) can cause extensive losses and is the major disease of faba beans in Western Australia (WA). The disease is seed-borne and crops may also be infected by wind-borne spores from residues of previous crops. As chocolate spot spores can survive in the soil for several years, there should be a rotation of at least three to four years before faba beans are grown on the same ground. [13]

The symptoms of chocolate spot are spots that range from small leaf spots to blackening of the entire plant. Leaves are the main areas affected, but under favourable conditions, the disease may also affect stems, flowers and pods (Photos 1–6).

The disease usually occurs in two phases: first a 'passive' phase where reddish-brown spots are peppered over the leaves and stem; and then an 'aggressive' phase, where tissue around the spots is rapidly killed, leaving large black or grey blighted sections on plant parts.

Photo 1: *Two examples of chocolate spot leaf lesions. Infections of chocolate spot in beans start as small brown spots and can expand across the leaf.*

Photos: SARDI

13 DAFWA (2015) Growing broad beans in Western Australia, Department of Agriculture and Food, Western Australia, https://agric.wa.gov.au/n/3762

Photo 2: *Poor podset and leaf loss from failing to protect against chocolate spot early.*

Photo: Pulse Australia

Photo 3: *Chocolate spot on flowers will prevent podset.*

Photo: SARDI

Photo 4: *Sporulation of chocolate spot on faba bean stems.*

Photo: Grain Legume Handbook, 2008

Photo 5: *Chocolate spot lesion on pod, leading to infection and staining on seed.*

Photo: SARDI

Photo 6: *Stained faba beans as a result of chocolate spot infection.*

Photo: SARDI

9.3.2 Economic Importance

Chocolate spot occurs in all areas where faba beans are grown. Losses range from minor to complete crop failure, depending on the severity and time at which infection occurs and the amount of spring rainfall.

In unprotected crops, the disease commonly reduces yields by 30–50% in a bad year, mainly by preventing podset (Photos 3 and 4).

Seed from badly affected plants may have a reddish-brown stain, which lowers its market value (Photo 6).

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 (*Alternaria alternata*) to infect the plants. Correct disease identification is necessary to avoid unnecessary spraying or incorrect fungicide use. [14]

9.3.3 Disease cycle

The fungus can survive in crop debris, in infected seed, or on self-sown plants. Infection usually begins when spores originating in infested faba bean trash are carried onto new crops by wind. Spores can be carried over long distances. Chocolate spot may also be introduced into new faba bean-growing districts by sowing infected seed. It can spread rapidly within a crop.

Chocolate spot is favoured by warm (15–25°C), humid conditions (>70% RH) that extend for four to five days. It typically develops later in the season, during flowering and after canopy closure. Yield loss due to chocolate spot results from pod abortion and plant damage. [15]

9.3.4 Control

The control of chocolate spot should follow the principles of integrated disease management (IDM) which include:

- crop rotation and paddock selection
- growing resistant varieties (Table 1)
- clean seed and fungicide seed dressings
- canopy management through time of sowing, seeding rate and row spacing
- regular crop monitoring
- strict hygiene on and off the farm
- strategic use of foliar fungicides.

Varieties with resistance to the disease should be grown in areas where the likelihood of chocolate spot is high.

Disease risk can be reduced by destroying all faba bean trash and self-sown plants before sowing, and by sowing disease-free seed in a crop rotation. Delayed sowing also reduces disease risk.

Seed dressings (Table 2) are not usually required, and only protect the emerging seedling from seed-borne *Botrytis* and common root rots.

Fungicides can be used to control the disease (see Table 4) and are generally used as protectants.

Fungicides available for chocolate spot include those containing mancozeb, chlorothalonil, carbendazim or procymidone. Copper products may have some efficacy. Chocolate spot is targeted in critical period 2, as well as critical period 3 (see Table 5).

14 Pulse Breeding Australia (2013) Southern/Western Faba & Broad Bean—Best Management Practices Training Course. Module 6—Disease Management.

15 Pulse Breeding Australia (2013) Southern/Western Faba & Broad Bean—Best Management Practices Training Course. Module 6—Disease Management.

If chocolate spot incidence 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. 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.

For carbendazim, observe the withholding period for grain prior to harvest (30 days). To ensure chocolate spot is controlled before it has a significant impact on the yield of the crop, the crop should be checked for disease every 7 days while the temperature remains below 15°C. If the weather is mild with day temperatures between 15°C and 20°C and humidity >70%, crop inspections should be made every 3 days.

Spraying to control chocolate spot 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. [16]

9.3.5 Variety choice

Moderately resistant (MR)

There are no moderately resistant (MR) varieties available currently.

Varieties with some resistance to chocolate spot may require fewer and later fungicide applications for chocolate spot (*Botrytis*) control. The disease simply moves slower in these varieties, but will be devastating if left unprotected in situations of high disease pressure. [17]

Moderately susceptible (MS)

Varieties: PBA Rana(ɒ), Nura(ɒ), PBA Samira(ɒ)

If the disease is present or the risk is deemed to be high, apply an early foliar fungicide for chocolate spot, either just before canopy closure or before flowering. Repeating foliar fungicide applications during flowering and podding will help to ensure leaves are free of lesions. Application at late podding may be required to protect grain quality in high-risk situations or if the disease is present. 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 need just as many fungicide applications for Botrytis control as a susceptible variety. The disease does move slower in these varieties, but will be devastating if left unprotected in medium to high disease pressure situations. [18]

Susceptible (S)

Varieties: Farah(ɒ), Fiesta VF(ɒ)

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 to be high. Repeat applications will be needed during flowering and podding, until flowering finishes and there is no more new growth. Ensure leaves are free of lesions so that grain can be

16 Pulse Breeding Australia (2013) Southern/Western Faba & Broad Bean—Best Management Practices Training Course. Module 6—Disease Management.

17 Pulse Breeding Australia (2013) Southern/Western Faba & Broad Bean—Best Management Practices Training Course. Module 6—Disease Management.

18 Pulse Breeding Australia (2013) Southern/Western Faba & Broad Bean—Best Management Practices Training Course. Module 6—Disease Management.

filled and to protect grain quality in high-risk or disease-pressure situations. These varieties will have minimal Botrytis in the pods if the leaf canopy is kept clean of the disease. [19]

9.4 Ascochyta blight

9.4.1 Symptoms

Ascochyta blight (*Ascochyta fabae*) occurs in all faba bean growing areas of WA. It is yield limiting in the medium and high-rainfall areas of the central and southern agricultural regions. Ascochyta blight usually appears within 8 weeks of sowing. [20]

Ascochyta blight starts as grey spots that show through both sides of leaves (Photo 7). Ascochyta spots become irregularly shaped, and they may merge to cover most of the leaf surface (Photo 8).

Leaf tissue next to the affected patches may become black and die off. Many tiny black fruiting bodies develop within the patches as the disease progresses. The pale centres may fall out, leaving holes in leaves (Photo 9).

Patches on the stem tend to be elongated, sunken and darker than the leaf lesions, and are usually covered with scattered fruiting bodies. The stems may split and break at the point of infection, causing plants to lodge (Photos 10 and 11).

On pods, the infected patches are black and sunken (Photo 12). Well-developed patches can penetrate the pod and infect the developing seeds. Infected seeds may be smaller than normal and discoloured. Badly infected pods may split open and seeds can have brown or black stains (Photo 13).

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 (*Alternaria alternata*) to infect. Correct disease identification is necessary to avoid unnecessary spraying or incorrect fungicide use (Photo 14).

Photo 7: *Infections start as small grey spots and may spread to the leaf edge following moisture run. Inset: Ascochyta lesion.*

Photo: Grain Legume Handbook, 2008

19 Pulse Breeding Australia (2013) Southern/Western Faba & Broad Bean—Best Management Practices Training Course. Module 6—Disease Management.

20 .DAFWA (2016) Faba bean: Ascochyta blight disease. Department of Agriculture and Food, Western Australia, https://agric.wa.gov.au/n/332

Photo 8: *Typical Ascochyta blight lesion.*

Photo: SARDI

Photo 9: *Older infections turn pale with black specks.*

Photo: Grain Legume Handbook, 2008

Photo 10: *Stem infections are sunken with pale centres. Ascochyta blight on bean stems causes stem breakage and lodging.*

Photo: Grain Legume Handbook, 2008

Photo 11: *Severe stem infections can cause complete blight of stems (on left).*

Photo: Grain Legume Handbook, 2008

Photo 12: *Ascochyta blight pod lesions are black and sunken and affect seed quality. They range from small isolated spots to the large multiple infection sites shown here. Timely protection is required: it is all too late when it gets to this stage.*

Photo: DPI Vic

Photo 13: *Faba bean grain with Ascochyta blight damage.*

Photo: SARDI

Photo 14: *Spotting from herbicide application can look like Ascochyta blight or Cercospora leaf spot, but note the absence of pycnidia (fruiting structures).*

Photo: SARDI

9.4.2 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 (5–15°C) conditions and usually develops early in the growing season. Damage from stem infection often results in serious crop lodging in susceptible varieties. However, the development of this disease can also be important late in the season. Pod infection with Ascochyta blight can cause seed staining and the subsequent downgrading of faba bean grain. [21]

9.4.3 Control

Use varieties that have some resistance. In the central and southern agricultural areas of WA, varieties that are at least moderately resistant to Ascochyta blight (such as Fiesta VF(l)) should be used. More resistant varieties (such as Farah(l)) will be required in southern high-rainfall areas that favour the disease.

Avoid paddocks in which faba beans have been grown in the past three to four years or which are within 500 metres of stubble from the previous year's crop.

In areas where faba beans have not been grown, or not grown for several years, take care not to introduce the disease by sowing infected seed.

Resistant varieties should not require foliar fungicide sprays for Ascochyta blight. On more susceptible varieties, in areas where Ascochyta blight occurs regularly, fungicidal sprays may be required early in the season. [22]

21 Pulse Breeding Australia (2013) Southern/Western Faba & Broad Bean—Best Management Practices Training Course. Module 6—Disease Management.

22 DAFWA (2016) Faba bean: Ascochyta blight disease. Department of Agriculture and Food, https://agric.wa.gov.au/n/332

Seed dressings (Table 2) only protect the emerging seedling from seed-borne Ascochyta and seed-borne Botrytis infection. Seed dressings will not protect the emerged seedling from rain-drop-splashed Ascochyta or wind-borne Botrytis.

It is recommended that seeds not be treated.

Ascochyta management strategies should be based on the principles of IDM, which include:

- crop rotation and paddock selection
- growing resistant varieties (Table 1)
- clean seed and fungicide seed dressings
- regular crop monitoring
- strict hygiene on and off the farm
- strategic use of foliar fungicides

9.4.4 Variety choice

Resistant (R)

Varieties: PBA Rana(b), Nura(b), Farah(b), PBA Samira(b),

Only consider applying an early foliar fungicide for Ascochyta blight if the disease is present and the risk is high.

A foliar fungicide applied during podding is unlikely to be required to protect grain quality in most situations. These varieties have resistance to Ascochyta blight in the pods.

Varieties with resistance to Ascochyta blight require fewer and later fungicide applications for control, if at all. This may result in the early development of chocolate spot infection, which would have normally been controlled as a result of fungicide applied for early Ascochyta blight in less-resistant varieties. Early monitoring and control of chocolate spot is still critical in Ascochyta-resistant varieties.

Susceptible (S)

Varieties: Fiesta VF(b)

Foliar fungicide applications for Ascochyta blight control will be necessary in most areas, and commencing early. Apply a fungicide before the disease is detected, from early emergence (six to eight weeks) through flowering and until four weeks before maturity. Starting early with protective applications is critical, as control is often ineffective if fungicides are applied after the disease has taken hold. [23]

9.5 Sclerotinia stem rot

9.5.1 Symptoms

Reported incidences of Sclerotinia infection in lupin crops have increased across WA's southern grain-growing districts. While the focus of reports is on canola and lupins, other pulse crops, including faba beans, chickpeas, field peas and lentils, may be threatened by Sclerotinia. As there is already a high incidence of Sclerotinia in canola in some areas of WA, there are high levels of Sclerotinia in the soil, so the risk of Sclerotinia causing economic losses in lupins and other pulse crops has increased. However, the degree of incidence and severity of Sclerotinia in lupins, chickpeas, faba beans, field peas and lentils is not yet known and useful control strategies may need to be researched or given extension support. [24]

MORE INFORMATION

GRDC (2014) Sclerotinia stem rot in canola. Fact sheet. GRDC.

23 Pulse Breeding Australia (2013) Southern/Western Faba and Broad Bean—Best Management Practices Training Course. Module 3—Varieties.

24 A Meldrum (2015) Sclerotinia survey for lupins and pulses. Extension Hub, https://www.extensionhub.com.au/web/field-crop-diseases/display/-/asset_publisher/ZQCuEErcXxu9/content/sclerotinia-survey-for-lupins-and-pulses/pop_up?_101_INSTANCE_ZQCuEErcXxu9_viewMode=print&_101_INSTANCE_ZQCuEErcXxu9_languageId=en_AU

Sclerotinia stem rot (which is caused by *Sclerotinia trifoliorum* var. *fabae, S. sclerotiorum, S. minor*) can attack plants at any stage of growth. Sclerotia (2–5 mm in diameter) form on the surface of infected plants and in the central cavity of the stem. These sclerotia are usually white at first, then turn black. The disease usually affects isolated plants, rather than patches of plants, in crops.

In young plants the infection usually begins close to ground level and a slimy rot extends into the stem and down into the roots. Older plants can get the infection on any part of their stems, leaves or pods. Infected plants suddenly wilt and collapse and are easily pulled from the soil.

9.5.2 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 faba beans are not grown.

Sclerotinia may act as either a leaf or a root disease. The foliar form of the disease may be spread by airborne 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.

While damage to the foliage from any source encourages Sclerotinia infection, the fungus can also infect uninjured tissue.

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

9.5.3 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 so can be used in the rotation.

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

9.6 Botrytis grey mould

9.6.1 Background

Botrytis grey mould (BGM) in faba beans is caused by *Botrytis cinerea.* It is a minor problem compared with chocolate spot (*Botrytis fabae*). The control of BGM in faba beans is the same as for chocolate spot. As with chocolate spot, flowers are especially vulnerable to BGM infection.

9.6.2 Economic importance

Botrytis grey mould and chocolate spot are sometimes found in association. Occurrence is worst in wet seasons, particularly when crops develop very dense canopies.

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

9.6.3 Biology and epidemiology

The life cycle of BGM in faba is similar to that of chocolate spot.

Botrytis cinerea has been recorded on over 138 genera of plants in 70 families. This wide range of hosts and saprophytic capacity means that the inoculum of *B. cinerea* is rarely limited; if conditions favour infection and disease development, BGM will occur.

This makes management of BGM different from that of Ascochyta blight, which is more dependent on inoculum, at least in the early phases of an epidemic. [25]

9.7 Root rots

9.7.1 Symptoms

Root rots in faba beans are caused by many pathogens: *Fusarium spp*. *Pythium spp*. *Rhizoctonia solani* and *Phoma medicaginis* var. *pinodella*.

Seedlings affected by root rot gradually turn black and their leaves droop. The plants usually do not collapse completely. The taproot may become quite brittle (except in Pythium root rot, where they become 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, which are often scattered through a crop, dry off prematurely.

In some cases, seeds may rot before they emerge.

9.7.2 Economic importance

Root rot can occasionally be a serious disease, especially when soils are wet for prolonged periods.

9.7.3 Disease cycle

As all the fungi responsible for root rot are soil dwellers, soil is the most important medium of transmission. The fungi can survive from crop to crop in the soil, either on infected plant debris or as resting spores.

Wet soils help these fungi invade plant roots, where they repress root development. Wet conditions also encourage the spread of the disease within a field. The reduced root development causes the plants to die when they are stressed.

Spores of the fungus produced on crop residue can be carried onto the new crop by wind. Infection can occur at any stage of plant growth, provided conditions are favourable. Moisture is essential for infection to occur.

During wet weather, the disease may spread further, with spores of the fungus being carried onto neighbouring plants by wind and rain-splash.

Severe pod infection can result in reduced seed set and infected seed.

9.7.4 Control

The disease can be reduced by crop rotation. As this disease may also affect other pulses, faba beans should be sown in rotation with another non-legume crop. Although faba beans are deemed to be reasonably tolerant of waterlogging, they should not be grown in areas subject to severe waterlogging.

Damping-off can be controlled using fungicidal seed treatment, but this is not common practice with faba beans.

Disease risk can be reduced by planting clean seed to prevent disease build-up. [26]

MORE INFORMATION

C Benjamin (2013) New faba bean rust option. Ground Cover. No. 106. September–October 2013. GRDC.

25 Pulse Breeding Australia (2013) Southern/Western Faba and Broad Bean—Best Management Practices Training Course. Module 6—Disease Management.

26 Pulse Breeding Australia (2013) Southern/Western Faba & Broad Bean—Best Management Practices Training Course. Module 6—Disease Management.

9.8 Rust

9.8.1 Symptoms

Rust is most prevalent in the warmer faba bean-growing areas, and is not widespread in WA. Rust (*Uromyces viciae-fabae*) appears on leaves as numerous small, orange–brown pustules, surrounded by a light yellow halo (see Photos 15 and 16). As the disease develops, severely infected leaves wither and drop off (Photo 17). The rust pustules on the stems are similar to, but often larger than, those on the leaves. Late in the season, stem lesions darken as resting spores of the fungus are produced in pustules (Photo 18).

Isolated rust pustules may also appear on the pods. A severe rust infection may cause premature defoliation, resulting in smaller seeds. [27]

Photo 15: *Young rust infections have a pale yellow ring; by comparison, there is with no ring around chocolate spot infection (at pencil tip).*

Photo: Grain Legume Handbook, 2008

27 Pulse Breeding Australia (2013) Southern/Western Faba & Broad Bean—Best Management Practices Training Course. Module 6—Disease Management.

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

Photo: SARDI

Photo 17: *Leaves can be heavily infected with rust.*

Photo: Grain Legume Handbook, 2008

Photo 18: *Rust on faba bean stem.*

Photo: Grain Legume Handbook, 2008

MORE INFORMATION

C Benjamin (2013) New faba bean rust option. Ground Cover. No. 106. September–October 2013. GRDC.

9.8.2 Disease cycle

The fungus survives on stubble trash and infects self-sown bean plants directly, without the need for alternative hosts. Rust spores can be blown long distances onto new crops by the wind. Pustules form on the first few plants to be infected, and the disease spreads from these. Rainfall or dew is necessary for infection, but as infection can occur after only 6 hours of leaf wetness, it does not require extended wet periods to take hold.

Rust can occur from early- to mid-spring on, and is favoured by warm temperatures (>20°C). [28]

9.8.3 Control

Growing resistant varieties will reduce the risk of disease infections (see Table 1). Prevention is difficult because the fungus spores can be carried such long distances by wind.

Risk of the disease can be reduced by burning or burying old faba bean stubbles, and by rotating crops.

Fungicides may be used to control the disease and prevent a rust epidemic (see Tables 3) in areas where the disease is most prevalent. Several sprays will be necessary for adequate disease control. [29]

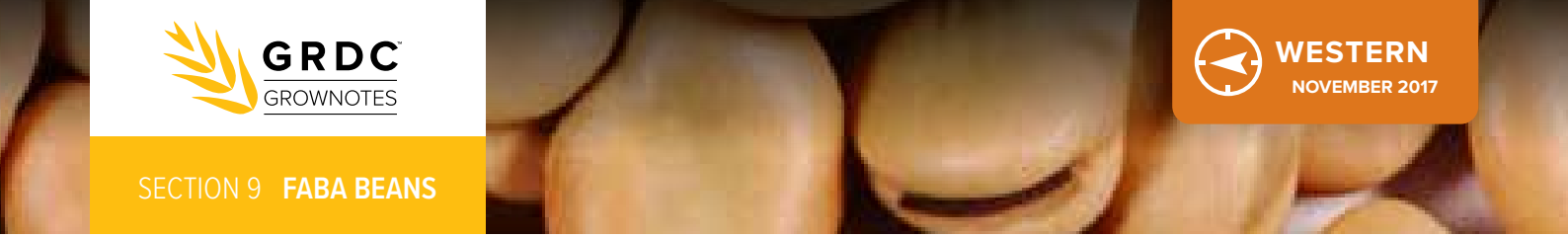
9.9 Rhizoctonia bare patch

Description

Rhizoctonia bare patch (*Rhizoctonia solani*) occurs on most soil types in the WA wheatbelt. The fungus causes root disease that results in the development of bare patches that look similar in all crop and pasture species.

28 Pulse Breeding Australia (2013) Southern/Western Faba & Broad Bean—Best Management Practices Training Course. Module 6—Disease Management.

29 Pulse Breeding Australia (2013) Southern/Western Faba & Broad Bean—Best Management Practices Training Course. Module 6—Disease Management.



MORE INFORMATION

GRDC (2016) Rhizoctonia: western region. Tips and Tactics. GRDC.

GRDC (2014) New treatment for Rhizoctonia. Driving Agronomy Podcasts. 21 July 2014. Audio file. GRDC.

A Wherrett (2016) Rhizoctonia – Western Australia. Fact sheet. Soil Quality.

It survives as fine fungal threads in organic matter. Following summer–autumn rains the fungus grows out of this material to infect the roots of young seedlings. Distinct patches of stunted or dying plants start to show four to six weeks after sowing. Patches are roughly circular with a diameter varying from 0.5–5 m; they may be elongated in the direction of sowing. There is almost no yield within the patches, and weeds in the patch are usually also affected.

Rhizoctonia is likely to be more severe where the fungus has been allowed to infect grass weeds or volunteer cereals prior to seeding.

Management strategies

Rhizoctonia bare patch has a wide range of hosts and cannot be controlled by rotating crops.

Tillage to a depth of 10–15 cm at about the time of sowing reduces the number and severity of patches. Modification of seeding machinery to cultivate 5–10 cm below the sowing depth will provide effective disease control in direct-drilled crops. Patches can also be controlled by deep ripping (25–30 cm) immediately before or after seeding. [30]

Summer rainfall events of at least 20 mm in the absence of weeds will reduce the inoculum levels in the soil and may reduce the disease impact. Early green-bridge control (i.e. control of weeds and crop volunteers) is a helpful cultural practice in paddock preparation. [31]

9.10 Viruses

Fortunately only few viruses are of major economic importance in Australia (Table 9).

Major viruses known to infect faba beans in Australia include:

- Bean leaf roll virus (BLRV)
- Beet western yellow virus (BWYV)
- Soybean dwarf virus (SBDV), syn. Subterranean clover red leaf virus (SCRLV)
- Subterranean clover stunt virus (SCSV)
- Clover yellow vein virus (ClYVV)
- Bean yellow mosaic virus (BYMV)
- Pea seed-borne mosaic virus (PSbMV)

Less common viruses that occur in Australia are:

- Alfalfa mosaic virus (AMV)
- Tomato spotted wilt virus (TSWV)
- Broad bean wilt virus (BBWV)
- Cucumber mosaic virus (CMV)

Except for TSWV, which is transmitted by specific thrips species, these viruses need aphid vectors to spread from infected to healthy plants.

30 DAFWA (2015) Diagnosing rhizoctonia bare patch in grain legumes. Department of Agriculture and Food Western Australia, https://www.agric.wa.gov.au/mycrop/diagnosing-rhizoctonia-bare-patch-grain-legumes-0

31 DAFWA (2016) Control of green bridge for pest and disease management. Department of Agriculture and Food Western Australia, https://www.agric.wa.gov.au/grains/control-green-bridge-pest-and-disease-management

Table 8: *Virus categories and general symptoms*

Virus	Aphid transmission	Seed transmission*	Visual symptom type	Visual symptoms	Virus type (genus)
AMV Alfalfa mosaic virus	Non-persistent	Yes	Shoot tip	Necrotic or chlorotic local lesions, sometimes mosaics that do not necessarily persist	Alfamovirus
BBWV Broad bean wilt virus	Non-persistent	No	Mosaic, shoot tip	Vein clearing, mottling and necrosis of shoot apex, plant wilts, mottled, malformed and stunted	Fabavirus
BLRV Bean leaf roll virus	Persistent	No	Top yellowing	Upward leaf-rolling accompanied by interveinal yellowing of older leaves and flowers abscised	Luteovirus
BWYV Beet western yellow virus	Persistent	No	Top yellowing	Interveinal yellowing of the older or intermediate leaves. Mild chlorotic spotting, yellowing, thickening and brittleness of older leaves	Luteovirus
BYMV Bean yellow mosaic virus	Non-persistent	Yes	Mosaic	Transient vein chlorosis followed by obvious green or yellow mosaic. Usually no leaf distortion	Potyvirus
CMV Cucumber mosaic virus	Non-persistent	Yes	Shoot tip	Mosaics, stunting and possibly some chlorosis	Cucumovirus
ClYVV Clover yellow vein virus	Non-persistent	No	Shoot tip, mosaic	Mosaics, mottles or streaks, vein yellowing or netting	Potyvirus
PSbMV Pea seed-borne mosaic virus	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 Subterranean clover red leaf virus	Persistent	No	Top yellowing	Mild yellowing, stunting and reddening	Luteovirus
SCSV Subterranean clover stunt virus	Persistent	No	Top yellowing	Top yellows, tip yellows or leaf roll. Leaf size reduced, petioles and internodes shortened	Nanavirus

Virus	Aphid transmission	Seed transmission*	Visual symptom type	Visual symptoms	Virus type (genus)
TSWV Tomato spotted wilt virus	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 beans is minimal for all viruses, and of no epidemiological significance. It is, however, significant in terms of quarantine and keeping foreign virus strains out of Australia

Source: PBA

In some seasons, viruses can become a problem in faba bean crops. Viruses such as BLRV, BWYV and, to some extent, (PSbMV) are not seed transmitted, but they become established after aphid-vector activity.

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

- Infected seed or proximity to a substantial virus reservoir (e.g. lucerne, summer weeds, field peas for PSbMV).
- High summer–autumn rainfall and the subsequent uncontrolled multiplication of aphids on host plants. Early aphid flights to newly emerged crops can cause early infection and economic loss as infected plants act as a reservoir for further spread of infection within the crop.

Photo 19: *Tomato spotted wilt virus (TSWV) ring spot lesions.*

Photo: Joop Van Leur, NSW DPI

Photo 20: *Tomato spotted wilt virus (TSWV) stem and tip necrosis.*

Photo: Joop Van Leur, NSW DPI

Photo 21: *Tomato spotted wilt virus (TSWV) pod necrosis.*

Photo: Joop Van Leur, NSW DPI

Photo 22: *Necrosis of the growing tip can be caused by thrips feeding, not by TSWV.*

Photo: Joop Van Leur, NSW DPI

Photo 23: *Stem necrosis can be caused by other causes than TSWV, in this case chocolate spot.*

Photo: Joop Van Leur, NSW DPI

Photo 24: *Stem necrosis can be caused by other causes than TSWV, in this case frost.*

Photo: Joop Van Leur, NSW DPI

Photo 25: *Bean yellow mosaic virus (BYMV) in faba bean.*

Photo 26: *Bean seed showing Pea seed-borne mosaic virus (PSbMV) marking that can affect marketability.*

Photo: R. Kimber, SARDI

Photo 27: *Subterranean clover stunt virus (SCSV) in very early-sown beans.*

Photo: Wayne Hawthorne, Pulse Australia

Photo 28: *Soybean dwarf virus (SBDV) is also known as subterranean clover red leaf virus (SCRLV).*

Photo: Joop Van Leur, NSW DPI

9.10.1 Control

Aphids are the major means by which viruses enter faba bean crops. Aphids move between adjacent plants to feed, before colonising faba beans plants. The result is that faba bean crops show a characteristic scattered distribution of patches of virus-infected plants. This contrasts with crops such as chickpeas, in which aphids do not colonise, and only individual plants are infected.

Aphid activity is influenced by seasonal conditions and will require early monitoring in nearby crops and pastures.

There are no totally proven control measures for viruses. Virus management in pulses aims at prevention through integrated management practice that involves controlling the virus source and aphid populations, and minimising virus transmission into and within the pulse crop.

Application of seed and foliar insecticides aimed at preventing feeding by aphids can help, but needs further confirmation that they can prevent infection by viruses.

Rotate pulse crops with cereals to reduce virus and vector sources and, where possible, avoid proximity to perennial pastures (e.g. lucerne) or other crops that host viruses and aphid vectors. Eliminate summer weeds and self-sown pulses that are a green-bridge host for viruses and a refuge for aphids and their multiplication.

Virus risk can be managed by combining a number of different control measures:

- Suppressing the virus source within the crop. Sow seed with <0.1% seed infection.
- Distancing crops from lucerne, weeds and other species that act as a reservoir for viruses, disease and aphids.

MORE INFORMATION

GRDC (2010) Aphids and viruses in pulse crops. Fact sheet. GRDC.

GRDC (2010) Green bridge. Fact sheet. GRDC.

GRDC (2015) Reducing aphid and virus risk. Tips and Tactics. GRDC.

E Leonard (2010) Smarter pest management. Ground Cover. No. 86. May–June 2010. GRDC.

- Controlling volunteer weeds during summer and autumn.
- Using a seed treatment of Gaucho 350SD® (imidacloprid), which is registered for early aphid protection to control persistently transmitted viruses.
- Retaining cereal stubble to deter aphids and decrease aphid landing rates.
- Sowing at recommended plant densities to achieve early closure of the crop canopy (closed canopies deter aphids)— note high seeding rates and narrow row spacing to provide early canopy closure assists in aphid control, but conflicts with management of fungal diseases.
- Sowing at recommended times to avoid autumn aphid flights.
- Ensuring that faba bean plants are made less attractive to aphids by minimising seedling disease, herbicide damage and poor nutrition.

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. [32]

9.11 Sample preparation for diseased plant specimens

For accurate diagnoses it is important that specimens are carefully selected, well presented and submitted with the correct forms.

For information about plant disease and virus testing, sample submission forms and sampling techniques, contact:

DDLS Specimen Reception
Tel: 08 9368 3351
Email: ddls-stac@agric.wa.gov.au

32 Pulse Breeding Australia (2013) Southern/Western Faba and Broad Bean—Best Management Practices Training Course. Module 6—Disease Management.