

 MORE INFORMATION

GRDC 'Crop Disease Au App':
<https://grdc.com.au/apps>

GRDC 'Grains Legume Handbook – Chapter 7 Disease Identification and Control': <https://grdc.com.au/grainlegumehandbook>

GRDC 'The current and potential costs from diseases of pulse crops in Australia': <https://grdc.com.au/Resources/Publications/2012/06/The-Current-and-Potential-Costs-from-Diseases-of-Pulse-Crops-in-Australia>

DPIRD 'Lupin diseases': <https://www.agric.wa.gov.au/lupins/lupin-foliar-diseases-diagnosis-and-management>

DPIRD-GRDC MyCrop 'Lupin diagnostic tool': <https://www.agric.wa.gov.au/lupin-diagnostic-tool>

DPIRD Diagnostic Laboratory Services (DDLS) —Plant Pathology: <https://www.agric.wa.gov.au/ddls-seed-testing-and-certification>

CropPro: http://www.croppro.com.au/crop_disease_manual/ch10.php

Australian Pesticides and Veterinary Medicine Association (APVMA):
<http://apvma.gov.au/>

Foliar diseases

8.1 Overview

The main fungal and viral diseases affecting lupin foliage, stems and pods in Western Australia are:

- » Anthracnose (*Colletotrichum lupini*)
- » Brown leaf spot (*Pleiochaeta setosa*)
- » Phomopsis stem and pod blight (*Phomopsis leptostromiformis* and *Diaporthe toxica*)
- » Cucumber mosaic virus (CMV)
- » Bean yellow mosaic virus (BYMV)
- » Sclerotinia stem and collar rot (*Sclerotinia sclerotiorum* and *Sclerotinia minor*).

Minor foliar diseases that can affect lupin crops in this State in some years include:

- » Grey leaf spot (*Stemphylium botryosum*)
- » Cladosporium leaf spot (*Cladosporium sp.*)
- » Grey mould (*Botrytis cinerea*)
- » Powdery mildew (*Erysiphe polygoni*).

Yield losses from foliar diseases in WA lupin crops are typically rare on the back of widespread use of fungicide-based seed dressings and foliar fungicides and adoption of wider crop sequences.

But several of the major diseases have potential to cause significant crop losses if left unchecked.

Damage can be prevented or curtailed with an integrated management approach involving variety choice, crop rotations, crop hygiene and targeted seed-based and foliar fungicide use.

Reducing the impact of these diseases will allow WA lupin production levels to be maintained. This, in turn, underpins cereal and canola production by supporting viable and profitable rotations – especially on the State's sandplain soils.

An overview of lupin diseases, symptoms and control tactics is outlined in Table 1¹

¹ CropPro (2016) Identification and management of field crop diseases in Victoria, GRDC and Department of Environment and Primary Industries Victoria, http://www.croppro.com.au/crop_disease_manual/

SECTION 8 LUPIN



Table 1: Lupin disease guide summary

Disease	Organisms	Symptoms	Occurrence	Inoculum source	Control
Brown leaf spot	<i>Pleiochaeta setosa</i>	Dark spots on leaves and pods, leaves drop off, lesions may girdle stem	Very common but losses usually minor in dry areas, yield loss can be significant in cool damp areas	Spores in soil and lupin trash, rain splash and wind blown rain splash and wind blown rain splash	Fungicide seed dressings, crop rotation, variety selection, early sowing
Pleiochaeta root rot	<i>Pleiochaeta setosa</i>	Browning and rotting of tap and lateral roots, seedling plant death	Serious reduction in lupin plant density and vigour	Spores in soil infecting roots usually at seedling stage, spread also by rain splash	Rotation minimum 4 years between lupin crops, sowing 4–5 cm deep to avoid spore layer, fungicide seed dressings
Rhizoctonia	<i>Rhizoctonia spp.</i>	Bare patches in crop, spear tipped root ends, hypocotyl rot and stain	Can be severe in isolated patches, reduces stand density, favoured by minimum tillage, wet soils and mild conditions	Soil-borne infection on wide host range, survives as fungal fragments in soil and plant debris	Tillage prior and during sowing, rotation has no effect, increased seeding rate
Anthracnose	<i>Colletotrichum lupini</i>	Stems bend over, sticky dark brown lesions in crook of bend, pods and leaves above crook twist and deform, dark lesions with pale centres on leaves, stems and pods	Severe infections can result in complete crop failure	Spores surviving in soil are transported by vehicles, machinery, animals and people, spread in crop by rain splash and wind	Clean seed and machinery, 4 year break between lupin crops, resistant varieties, fungicide seed dressings reduce seedling infection
Cucumber mosaic virus	Virus	All growth after infection is dwarfed, leaflets are yellowed and bunched	Early widespread infection Severely reduces yield. Minor infections prevent use of harvested grain as seed	Seed-borne infection in narrow leaf lupin, aphids transmit the disease within a crop	Sow clean seed, use a seed test, high sowing rates and cereal barriers around crops reduce aphid transmission
Bean yellow mosaic virus	Virus	Brown streaks on stem, shepherd crook, pods blackened and flat, plants wilt and die	Occurs in all lupin growing areas. Can be severe in higher rainfall areas	Seed-borne in albus, aphid spread in crop, many host species	Sow virus free seed. High plant density, cereal barrier

(SOURCE: http://www.croppro.com.au/crop_disease_manual/ch09s06.php)

2 CropPro (2016) Identification and management of field crop diseases in Victoria, GRDC and Department of Environment and Primary Industries Victoria, http://www.croppro.com.au/crop_disease_manual/

i MORE INFORMATION

DPIRD-GRDC MyCrop: <https://www.agric.wa.gov.au/mycrop/diagnosing-anthrachnose-narrow-leafed-lupins>

GRDC 'Grain Legume Handbook – Chapter 7 Disease Identification and Control': <https://grdc.com.au/grainlegumehandbook>

8.2 Anthracnose (*Colletotrichum lupini*)



Figure 2: Anthracnose was a severe disease of lupin crops in WA in the 1990s but incidence is now low.

SOURCE: SARDI

- Risk increases with rainfall, use of infected seed and disease susceptible varieties
- Albus, yellow and WA blue lupin more susceptible than narrow leafed lupin
- All above-ground parts of the plant can be infected
- Yield losses can be up to 50 percent
- Severe infection can lead to plant death
- Variety resistance can reduce the impact from seed-borne infection
- Registered seed dressings and foliar fungicides are effective control measures.

Anthracnose, caused by the fungus *Colletotrichum lupini*, is a highly destructive disease of lupin that can lead to total crop loss in susceptible varieties if not managed. But, typically, it can be eradicated from a paddock, farm or region by using correct rotations and hygiene practices, such as growing non-lupin crops for several years.

In recent years, use of resistant varieties, less sowing of infected seed and registration of foliar fungicides for anthracnose have reduced the impact of this disease in WA, especially in the northern agricultural region.

Continued improved management of anthracnose is expected to enable retention of lupin in crop sequences in disease susceptible areas and help reduce reliance on nitrogen (N) fertilisers and fungicides in cereal phases of the rotation.

The anthracnose pathogen survives on lupin stubbles and can persist for up to two years in (or on) infected seed, which will produce infected seedlings.

These seedlings produce lesions on the root, hypocotyl, cotyledons, leaf petioles or stems, which – in turn – create an abundance of spores.

Spores can be splashed on to surrounding plants by rain and have been shown to travel more than 100 metres to establish the disease in new crops.

Anthracnose-infected seed can cause significant yield losses (up to 50 percent in some trials) in all lupin varieties in WA due to the early establishment of infection.³

The most distinctive symptom of anthracnose in lupin is bending and twisting of stems, with a lesion in the crook of the bend. This is particularly noticeable at flowering.

³ Thomas, G (2004) Advanced management strategies for control of anthracnose and brown spot in lupins, GRDC Final Report, <http://finalreports.grdc.com.au/DAW665>

FEEDBACK

Stem lesions are usually dark brown, with a pale pinkish-orange spore mass in the lesion. The stem can be completely girdled by lesions, or so weakened that it breaks. Both the main stem and lateral branches can be affected and close inspection will often show similar symptoms on leaves.

Pods develop lesions similar to those on stems and are often twisted and distorted. Infections at this stage can result in complete loss of pods or production of infected seed.

Infected seed can appear symptomless, or can be malformed with discoloration, fungal mycelium or pink spores on the seed surface. Seed testing can detect presence and levels of infection.

Management of anthracnose

- » Use resistant varieties in high-risk environments
- » Test seed for presence and levels of infection and use clean seed
- » Thiram (Group M3)-based seed dressing fungicides can reduce disease transmission
- » Destroy or separate WA blue lupin from susceptible varieties
- » Mancozeb active (Group M3) is registered for foliar application
- » Under high disease pressure, foliar sprays are ideally applied at early podding on main stems and first order branches.⁴

The narrow leafed lupin varieties PBA Leeman[□], PBA Jurien[□], PBA Barlock[□], Mandelup[□] and Tanjil[□] are resistant to anthracnose, along with the albus variety Amira[□].

Research has shown anthracnose resistance is most strongly expressed in stem tissue, offering good protection from the impact of seed-borne infection. But resistant varieties can suffer significant yield losses from infection at the flowering and podding stages.⁵

It is recommended that resistant varieties are used in WA's high and medium rainfall zones, especially in the northern agricultural region, to reduce potential yield losses under disease pressure.

In some areas of WA, a degree of seed infection with anthracnose can be tolerated with minimal yield loss. This will depend on variety susceptibility, environment/rainfall zone, use of fungicide seed treatment and proximity of other sources of infection (such as WA blue lupin). To determine the suitability of lupin seed for sowing, it should be tested for the presence and amount of anthracnose infection.⁶

Commercial seed testing can be carried out by DPIRD Diagnostic Laboratory Services (DDLs)—Plant Pathology. For more information see this link: <https://www.agric.wa.gov.au/ddls-seed-testing-and-certification>

If there is zero anthracnose, there is typically no need to apply a seed dressing.

If there is anthracnose, previous research has found fungicide seed dressings with the active ingredient thiram (at a rate of about 1.7–2 Litres/tonne seed) can reduce seed transmission of anthracnose by about 75 percent. Thiram gives poor control of Brown leaf spot, but can be safely used in conjunction with fungicides containing iprodione or procymidone for protection from both diseases.⁷

4 DPIRD-GRDC (2016) MyCrop Diagnostic Tool – Diagnosing anthracnose in narrow-leafed lupins, <https://www.agric.wa.gov.au/mycrop/diagnosing-anthracnose-narrow-leafed-lupins>

5 Thomas, G (2004) Advanced management strategies for control of anthracnose and brown spot in lupins, GRDC Final Report, <http://finalreports.grdc.com.au/DAW665>

6 Thomas, G (2004) Advanced management strategies for control of anthracnose and brown spot in lupins, GRDC Final Report, <http://finalreports.grdc.com.au/DAW665>

7 Thomas, G (2004) Advanced management strategies for control of anthracnose and brown spot in lupins, GRDC Final Report, <http://finalreports.grdc.com.au/DAW665>

FEEDBACK

Trials carried out from 2001 to 2008 found some foliar fungicide actives could reduce anthracnose infection and lift crop yields in some varieties by up to 0.7 tonnes per hectare.⁸

Mancozeb (Group M3) is now registered for anthracnose control in lupin at rates of 1–2.2 kilograms/ha.

Trials have found the optimum spray timing of foliar fungicide is before infection and at podding on first branches.⁹

Fungicide spraying may be useful when more resistant varieties are not available or when lupin is grown in areas of high disease risk under high disease pressure.

Fungicide spraying can also facilitate the production of higher yielding moderately resistant (MR) varieties (such as Mandelup[□]) in high yield potential, but high disease risk areas (such as high rainfall parts of the northern agricultural region).¹⁰

Agronomic practices such as stubble retention/sowing into standing stubble (except for lupin stubble), avoiding sowing lupin following lupin, controlling volunteer lupin and planting away from any WA blue lupin have been shown to reduce the spread of anthracnose from infected seed.¹¹

i MORE INFORMATION

DPIRD-GRDC MyCrop: <https://www.agric.wa.gov.au/mycrop/diagnosing-brown-spot-narrow-leafed-lupins>

GRDC 'Grains Legume Handbook': <https://grdc.com.au/grainlegumehandbook>

8.3 Brown leaf spot (*Pleiochaeta setosa*)



Figure 3: Brown leaf spot can be widespread but is relatively simple to control.

(SOURCE: GRDC)

- Affects all varieties
- Cotyledons, leaves, stems and pods can be infected
- Control tactics include crop sequencing, resistant varieties, adequate crop nutrition and targeted fungicides
- Application of iprodione (Group 2) or procymidone (Group 2)-based seed dressing fungicides can reduce seedling infection.

Brown leaf spot (*Pleiochaeta setosa*) can be a widespread and costly foliar disease of lupin in WA, but yield losses are now typically rare due to use of full stubble retention and longer lupin sequences in crop rotations.

All species can be affected, including commonly grown narrow leafed varieties Mandelup[□], PBA Barlock[□] and new PBA Jurien[□] and the albus variety Amira[□].

8 Thomas, G (2004) Advanced management strategies for control of anthracnose and brown spot in lupins, GRDC Final Report, <http://finalreports.grdc.com.au/DAW665>

9 Thomas, G (2004) Advanced management strategies for control of anthracnose and brown spot in lupins, GRDC Final Report, <http://finalreports.grdc.com.au/DAW665>

10 Thomas, G (2004) Advanced management strategies for control of anthracnose and brown spot in lupins, GRDC Final Report, <http://finalreports.grdc.com.au/DAW665>

11 Thomas, G (2004) Advanced management strategies for control of anthracnose and brown spot in lupins, GRDC Final Report, <http://finalreports.grdc.com.au/DAW665>

FEEDBACK

Paddocks previously sown to lupin will have *Pleiochaeta* spores in the soil and these can persist for several years, making crop rotation with non-host species an integral control strategy.

Brown leaf spot infection occurs when spores are splashed by rain from the soil on to new lupin plants.

Crop damage can increase at early seedling stage, when plant growth rates are slowed by colder environments, late sowing, poor nutrition, herbicide damage or unfavorable soil type (loam and heavier soils are most prone). Damage at this stage tends to have the biggest impact on grain yield.

Infected cotyledons develop dark brown spots, rapidly become yellow and drop off.

Leaves develop dark brown spots, often become net-like, distorted and small and then drop off prematurely.

Brown flecks may be evident on infected stems and occasionally large brown-black cankers develop that kill the stem above the infection point.

Pods, particularly those set closer to the ground, may be flecked or develop larger brown lesions. Stem and pod infection are usually associated with leaf infection in the upper canopy.

Management of Brown leaf spot

- » Rotate lupin paddocks to non-host crops for at least one year
- » Sow lupin into retained cereal stubble to reduce rain splash of soil-borne spores onto foliage
- » Use agronomic practices that promote seedling vigour and canopy closure – early sowing, adequate nutrition, care in herbicide use and higher seeding rates
- » Select more tolerant narrow leafed lupin varieties
- » Iprodione or procymidone-based seed dressing fungicides are registered, with variable uptake between varieties.¹²

Seed dressing fungicides may be useful in high-risk areas, such as on loamy and heavy soil types and where stubble is not retained, to reduce Brown leaf spot infection in seedlings. But, on sandy soils, if stubble cover is high and there is no paddock history of Brown leaf spot, there is often no need to use a seed dressing.¹³

A potential agronomic issue for Brown leaf spot is weed control, with trials in 2000-04 finding disease damage to leaves could increase with the use of the herbicide simazine (Group C).¹⁴

Glasshouse research in 2004-08 found Mandelup[□] infected with Brown leaf spot could tolerate commonly used post-emergent herbicides (with the actives diflufenican (Group F) and metribuzin (Group C) applied at registered label rates) without affecting plant growth, development or yield. Under low brown leaf spot disease severity, these herbicides might increase disease severity and reduce yields.¹⁵

12 DPIRD-GRDC (2016) MyCrop Diagnostic Tool – Diagnosing brown spot in narrow-leafed lupins, <https://www.agric.wa.gov.au/mycrop/diagnosing-brown-spot-narrow-leafed-lupins>

13 DPIRD-GRDC (2016) MyCrop Diagnostic Tool – Diagnosing brown spot in narrow-leafed lupins, <https://www.agric.wa.gov.au/mycrop/diagnosing-brown-spot-narrow-leafed-lupins>

14 Thomas, G (2004) Advanced management strategies for control of anthracnose and brown spot in lupins, GRDC Final Report, <http://finalreports.grdc.com.au/DAW665>

15 Dhammu, H.S, MacLeod, W.J, Roberts, C, Payne, P.L.M, Antuono, M.F (2008) Interaction of brown leaf spot with post-emergent herbicides in narrow-leafed lupins, DAFWA, <http://www.lupins.org/pdf/conference/2008/Agronomy%20and%20Production/HS%20Dhammu%20W%20MacLeod%20C%20Roberts%20P%20Payne%20and%20M%20Antuono.pdf>



i MORE INFORMATION

DPIRD ‘Lupinosis’: <https://www.agric.wa.gov.au/livestock-biosecurity/lupinosis-sheep>

DPIRD-GRDC MyCrop: <https://www.agric.wa.gov.au/mycrop/diagnosing-phomopsis-stem-and-pod-blight-narrow-leafed-lupins>

8.4 Phomopsis stem and pod blight (*Phomopsis leptostromiformis*, *Diaporthe toxica*)



Figure 4: *Phomopsis* on lupin stem can typically be seen as purple lesions that bleach with age.

SOURCE: GRDC

- Phomopsis fungus infection can cause lupinosis in livestock
- Stems, leaves, pods and seed can be infected
- Narrow leafed varieties are more susceptible than albus lupin
- Control tactics include more resistant varieties and extending lupin crop sequences.

The major impact of phomopsis stem blight (*Phomopsis leptostromiformis*) and phomopsis pod blight (*Diaporthe toxica*) is production of a mycotoxin (*phomopsin*) as the fungus grows in mature lupin stems.

This can cause livestock sickness or death from lupinosis if grazing of infected stubble is poorly managed.

Crop symptoms of phomopsis usually appear on senescing lupin stems as dark-purplish lesions that bleach with age and contain black fruiting bodies. It can cause plants to lodge.

The fruiting bodies can develop on lupin stubble, often after summer rain, which stimulates growth of the fungus and the production of toxins.

Re-infected seedlings in subsequent crops develop deep-yellow to brown, irregular shaped lesions on stems below the cotyledons. Severe lesions may girdle the stem and kill the plant.

Pod lesions can lead to infected seeds, which appear as either normal or are discolored light yellow to reddish-tan. Web-like grey mould of the fungus may be seen on the seed coat and inside the seed pod.

Management of phomopsis

- » Use more resistant varieties in high-risk areas
- » Extend lupin phases in crop rotation planning
- » Destroy infected crop residues with burning or cultivation
- » Take care when grazing lupin stubbles in high-risk areas
- » Remove stock from lupin stubbles when summer rain is imminent.¹⁶

Narrow leafed lupin tends to be more prone to phomopsis stem and pod blight than albus lupin. But PBA Leeman[□], PBA Jurien[□], PBA Barlock[□] and Mandelup[□] have moderate resistance to both stem and pod infection.

¹⁶ DPIRD-GRDC (2016) MyCrop Diagnostic Tool – Diagnosing phomopsis stem and pod blight in narrow-leafed lupins, <https://www.agric.wa.gov.au/mycrop/diagnosing-phomopsis-stem-and-pod-blight-narrow-leafed-lupins>

If weather conditions favor the pathogen, including prolonged rainfall or high humidity in late spring and summer, stubble can develop some toxicity and require care with grazing.

But current commercial varieties do not produce highly toxic stubbles.¹⁷

Increasing breaks between lupin crops in the rotation allows weathering and breakdown of infected stubble, reducing disease inoculum.

8.5 Cucumber mosaic virus (CMV)

MORE INFORMATION

DPIRD 'Cucumber mosaic virus': <https://www.agric.wa.gov.au/grains-research-development/cucumber-mosaic-virus-narrow-leafed-lupins>

GRDC 'Fact Sheet Resistance Management Strategy for the Green Peach Aphid in Australian Grains': www.grdc.com.au/GPAResistanceStrategy

GRDC 'Back Pocket Guide Crop Aphids': <https://grdc.com.au/CropAphidsBackPocketGuide>



Figure 1: Cucumber mosaic virus is seed and aphid-borne and narrow leafed lupin varieties are more susceptible than albus lines.

(SOURCE: GRDC)

- Seed and aphid-borne
- Spread by sowing infected seed and via aphid vectors
- Seed testing for infection is advised
- Neonicotinoid-based insecticide can be used on seed
- Suppressing aphid transmission is a key management tactic.

Infected seed is the biggest source of Cucumber mosaic virus (CMV) incidence in lupin crops across WA. Narrow leafed varieties are more susceptible than albus lines.

A seed infection level of one percent means one plant in every 100 will typically be virus-infected and these will tend to be randomly distributed across the paddock.

Secondary infection occurs by aphids, which acquire the virus from primary infected plants (or weeds, clovers or other pulse crops) and spread it to healthy crops.

Aphid species that spread CMV include Green peach (*Myzus persicae*), Blue green (*Acyrtosiphon kondoi*) and Cowpea (*Aphis craccivora*) aphids that colonise lupin crops – as well as migrants of common non-lupin colonising species, especially Oat (*Rhopalosiphum padi*) and Turnip (*Lipaphis erysime*) aphids.

Areas most at risk from this virus in WA are the high rainfall zones of the northern and central agricultural grainbelt and the south coastal region.

CMV infection causes lupin leaves to become pale, bunched and down-curved with faint mosaic patterns.

It can severely stunt plant growth and the earlier a plant becomes infected, the fewer the pods set, the smaller the size of seed produced and the lower the crop yield.

¹⁷ DPIRD-GRDC (2016) MyCrop Diagnostic Tool – Diagnosing phomopsis stem and pod blight in narrow-leafed lupins, <https://www.agric.wa.gov.au/mycrop/diagnosing-phomopsis-stem-and-pod-blight-narrow-leafed-lupins>

FEEDBACK

With late infections, symptoms tend to be restricted to tip leaves.

As shown in Table 2, yield losses from CMV can be as high as 60 percent when all plants in a crop become infected. Losses are greatest when seed with more than one percent infection is sown, aphids arrive early and widespread plant infection occurs.¹⁸

Table 2: Effect of sowing Cucumber mosaic virus (CMV)-infected seed on yield and subsequent seed transmission (data from Western Australian field trials).

Scenario	1	2	3	4
Initial CMV seed infection level	5%	0.5%	5%	0.5%
Aphid arrival	Early	Early	Very late	Very late
Final crop infection	89–95%	34–53%	1–2%	0.1%
Yield loss	36–53%	ns	ns	ns
Harvested CMV seed infection level	12–13%	7%	0.6%	0.1–0.2%

NOTE: ns=yield impact is not statistically significant
(SOURCE: DAFWA)⁹

Management of CMV

- » Grow virus resistant varieties for optimum control
- » Sow tested seed with virus levels less than 0.1–0.5 percent
- » Eliminate weeds and self-sown pulses for aphid and disease control
- » Monitor and control aphids, especially during early crop growth
- » Rotate lupin crops with cereals to break disease cycles
- » If necessary, use seed treatment containing neonicotinoid-based insecticide
- » In-crop insecticides have shown to be ineffective in WA conditions.²⁰

Lupin varieties differ in rates of susceptibility to aphid colonisation and aphid-borne viruses, such as CMV. Further information about resistance ratings to this and other viruses can be found on the DPIRD website at this link: <https://www.agric.wa.gov.au/grains-research-development/management-aphids-western-australian-lupin-crops>²¹

Moderately resistant narrow leaved lupin varieties that are recommended for WA's high rainfall areas include PBA Leeman[□], PBA Jurien[□], PBA Barlock[□], PBA Gunyidi[□], Jenabillup[□], Coromup[□] and Mandelup[□].

The new albus variety Amira[□] has been found to be tolerant to aphids in WA conditions.

Sowing healthy lupin seed is key to managing CMV in lupin and testing seed is recommended every year.

Seed samples can be sent to commercial testing services, including DPIRD Diagnostic Laboratory Services (DLS)—Plant Pathology, to gauge infection levels.

In low-risk areas, seed with less than 0.5 percent infection can be sown without high risk of yield loss in 'typical' seasons. Seed infection of less than 0.1 percent (shown as

18 DPIRD (2016) Cucumber mosaic virus in narrow-leaved lupins, <https://www.agric.wa.gov.au/grains-research-development/cucumber-mosaic-virus-narrow-leaved-lupins?page=0%2C1>
 19 DPIRD (2016) Cucumber mosaic virus in narrow-leaved lupins, <https://www.agric.wa.gov.au/grains-research-development/cucumber-mosaic-virus-narrow-leaved-lupins?page=0%2C1>
 20 DPIRD (2016) Cucumber mosaic virus in narrow-leaved lupins, <https://www.agric.wa.gov.au/grains-research-development/cucumber-mosaic-virus-narrow-leaved-lupins?page=0%2C1>
 21 DPIRD (2016) Management of aphids in Western Australian lupin crops, <https://www.agric.wa.gov.au/grains-research-development/management-aphids-western-australian-lupin-crops>

a zero result from a 1000 seed test) is recommended for grain crops in high-risk areas and for seed certification crops in any rainfall zone. But the outcome of sowing seed infected with a range of levels of CMV will vary significantly from year to year and site to site.²²

Sowing seed with a high level of infection, coupled with early arrival of aphids can initiate early epidemics of CMV, with potential to result in high disease incidence, reduced yield and increased infection in harvested seed.

When there is a dry start to the growing season, sowing seed with a high level of infection can result in minimal yield loss and reduction in infection levels in harvested seed. The aphids arrive much later, tending to result in reduced CMV spread.

Seed dressing insecticides containing the active neonicotinoid have been found to help prevent crops from early feeding of aphids and can stop the infection of crops from viruses.

Agronomic practices, such as sowing early into retained stubble, away from neighboring lupin crops, at high seeding rates and using narrow row spacing, can promote early crop canopy coverage and deter aphids from landing.

This can shade over the seed-infected and early infected plants, denying aphids access.

Maximising weed control can also reduce the spread of CMV from lupin to weeds and from weeds back to lupin.

Research has found insecticides applied to crops are ineffective at controlling CMV.²³

MORE INFORMATION

DPIRD 'Bean yellow mosaic virus': <https://www.agric.wa.gov.au/lupins/bean-yellow-mosaic-virus-lupins>

GRDC 'Grains Legume Handbook': <https://grdc.com.au/grainlegumehandbook>

8.6 Bean yellow mosaic virus (BYMV)



Figure 2: *With Bean yellow mosaic virus, the youngest growth of the lupin plant tends to bend over - causing a 'shepherd's crook' appearance.*

(SOURCE: DAFWA)

- Spread by aphid species that colonise lupin
- Can be seed-borne in albus varieties (not narrow leafed lines)
- Crop yield losses can be up to 80 percent if unchecked
- Late summer and early autumn rain can increase spread
- Integrated disease management based on agronomic practices is needed
- Test for and sow virus-free seed.²⁴

22 DPIRD (2016) Cucumber mosaic virus in narrow-leafed lupins, <https://www.agric.wa.gov.au/grains-research-development/cucumber-mosaic-virus-narrow-leafed-lupins?page=0%2C1>

23 DPIRD (2016) Cucumber mosaic virus in narrow-leafed lupins, <https://www.agric.wa.gov.au/grains-research-development/cucumber-mosaic-virus-narrow-leafed-lupins?page=0%2C1>

24 DPIRD (2016) Management of aphids in Western Australian lupin crops, <https://www.agric.wa.gov.au/grains-research-development/management-aphids-western-australian-lupin-crops>

FEEDBACK

Bean yellow mosaic virus (BYMV) is a serious disease in WA narrow leafed lupin crops if not managed, especially in high rainfall areas of the northern agricultural region.

Disease risk is typically highest in seasons with high summer/autumn rainfall that promote early build-up and migration of aphids.

Crops neighboring clover-based pastures, or containing clover/weeds, are at the greatest risk of infection.

Two strains of BYMV are common in WA. The necrotic strain (BYMV-N) kills the infected plant and the less abundant non-necrotic (BYMV-NN) strain causes stunting without killing the plant.

DPIRD has a comprehensive guide to diagnosing BYMV in WA lupin crops at this link: <https://www.agric.wa.gov.au/mycrop/diagnosing-bean-yellow-mosaic-virus-non-necrotic-narrow-leafed-lupins>²⁵

BYMV-N symptoms include:

- » Occurs before pod set
- » Necrotic streaking of the youngest portion of the shoot
- » This bends over, causing a 'shepherd's crook' appearance
- » The growing tip dies
- » Leaves become pale, wilt and fall off
- » Necrotic streaking and blackening spread across the stem
- » Fast plant death without seed production.²⁶

BYMV-NN symptoms include:

- » Occurs after pod set and is rare
- » Virus is slower to spread
- » Stunted pale plants
- » Deformed and often fleshy leaves
- » Pods blacken and fail to fill while the rest of the plant grows normally (known as black pod syndrome).²⁷

Management of BYMV

- » Promote early crop canopy coverage – sow early, use high seeding rates and narrow row spacing
- » Direct drill into retained stubble – ground cover reduces aphid landing
- » Rotate lupin with non-host crops
- » Ensure good weed control
- » Insecticides applied in-crop are ineffective to control BYMV.²⁸

There is typically only a brief period between initial BWYV symptoms forming in young lupin crops and plant death.

This means incoming aphids can only acquire the virus from infected plants for one to two weeks and infection levels decline rapidly with increasing distance into the crop.

Management of this virus centres on agronomic practices that:

- » Eliminate clover/weed regrowth under lupin crops
- » Avoid sowing adjacent to clover based pastures
- » Deter aphid landing by reducing bare ground exposure.

25 DPIRD-GRDC (2016) MyCrop Diagnostic Tool – Diagnosing Bean yellow mosaic virus – non necrotic in narrow-leafed lupins, <https://www.agric.wa.gov.au/mycrop/diagnosing-bean-yellow-mosaic-virus-non-necrotic-narrow-leafed-lupins>

26 DPIRD (2016) Bean Yellow mosaic virus in lupins, <https://www.agric.wa.gov.au/lupins/bean-yellow-mosaic-virus-lupins>

27 DPIRD (2016) Bean Yellow mosaic virus in lupins, <https://www.agric.wa.gov.au/lupins/bean-yellow-mosaic-virus-lupins>

28 DPIRD (2016) Bean Yellow mosaic virus in lupins, <https://www.agric.wa.gov.au/lupins/bean-yellow-mosaic-virus-lupins>

This can be achieved by tactics such as promoting early canopy development, sowing into retained stubbles, using high seeding rates and adopting narrow row spacing.

High plant densities will tend to dilute the proportion of plants infected and increase compensatory growth of healthy plants.

Sowing a non-host crop (for example, a cereal) or a border strip between crops and adjacent pasture can also be effective, as incoming aphids lose the virus when they probe the non-host. This helps to reduce spread into the crop from an external source.²⁹

8.7 Sclerotinia stem and collar rot (*Sclerotinia sclerotiorum*, *Sclerotinia minor*)

MORE INFORMATION

DPIRD 'Sclerotinia': <https://www.agric.wa.gov.au/lupins/lupin-foliar-diseases-diagnosis-and-management> or www.agric.wa.gov.au/mycrop/diagnosing-sclerotinia-collar-rot-narrow-leafed-lupins



Figure 3: *Sclerotinia* can affect lupin pods.

(SOURCE: © Western Australian Agriculture Authority (Department of Agriculture and Food, WA))

- Sclerotinia stem rot is an increasing problem in WA lupin crops
- Most common in high rainfall areas
- Typically affects plants after flowering in warm and damp conditions
- Sclerotinia collar rot is less prevalent, but a potential issue in canola-lupin rotations
- Outbreaks are sporadic and yield losses are typically low
- In severe cases, sclerotia become mixed with harvested seed and incurs grain grading costs.

Incidence of sclerotinia stem rot (*Sclerotinia sclerotiorum*) has increased in WA cropping rotations in recent years, mostly as a result of expanded canola plantings.

Lupin crops in high rainfall parts of the northern grainbelt, especially west of Mingenew, were particularly affected by this disease during the wet winter growing seasons of 2013 and 2014.

In cases of sclerotinia collar rot (*Sclerotinia minor*), lesions and fluffy white growth appear on stems just above ground level and contain small black fruiting bodies called sclerotia.

This disease was seen in Mandelup² lupin crops in the central grainbelt at the mid-flowering stage in 2016, but it does not typically have a significant effect on crop yields.

Sclerotinia stem rot in lupin occurs during flowering, when ascospores infect petals.

Under constant humid and wet weather, infected petals fall and lodge in branches and infect stems and pods. It can take two or three weeks for in-crop symptoms to be seen.

29 DPIRD (2016) Bean Yellow mosaic virus in lupins, <https://www.agric.wa.gov.au/lupins/bean-yellow-mosaic-virus-lupins>

FEEDBACK

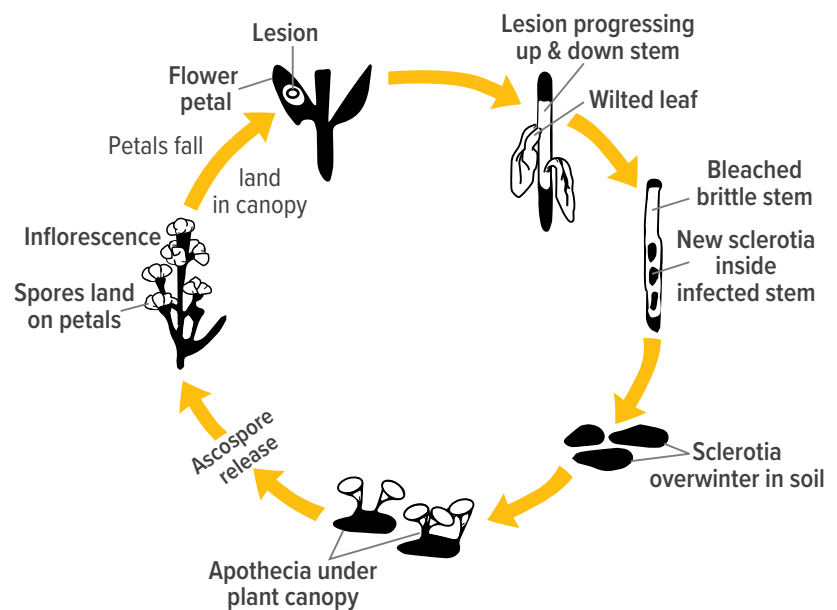
Sclerotinia stem rot symptoms include lesions in the upper half of the main stem, branches and on flowers and pods.

The fungus produces a white cottony-looking growth that girdles the stem, causing the plant parts above the lesion to wilt and die.

Individual pods or complete flower spikes can be completely covered by white fungal growth, which produces hard black sclerotia (of 2–8 mm in diameter).

Stems become bleached looking and infected plants stand out from the rest of the crop. The lifecycle of sclerotinia is illustrated in Figure 3.

Figure 4: *Sclerotinia sclerotiorum* disease cycle.



(SOURCE: DAFWA)³⁰

Lupin crops infected with sclerotinia can have lower yields due to plant death. In severe cases, grain requires grading after harvest to remove sclerotia.

Disease management can be difficult, as sclerotia can survive in the soil for many years.³¹

Management of sclerotinia

- » Rotate lupin crops with non-host species (cereals)
- » Avoid sowing lupin in close rotation with other broadleaf crops, such as canola
- » Control broadleaf weeds during the rotation
- » Foliar fungicides are not registered for sclerotinia in lupin.

Crop rotation with non-host species, such as cereals, and extended breaks between lupin and canola crops can help to break the sclerotinia disease cycle.

There are no foliar fungicides currently registered for treatment of sclerotinia in lupin crops.

30 Thomas, G, Beard, C (2015) Mingenew Irwin Group Presentation, <http://www.miq.org.au/author/zoe/page/3/>

31 Thomas, G, Beard, C (2015) Mingenew Irwin Group Presentation, <http://www.miq.org.au/author/zoe/page/3/>

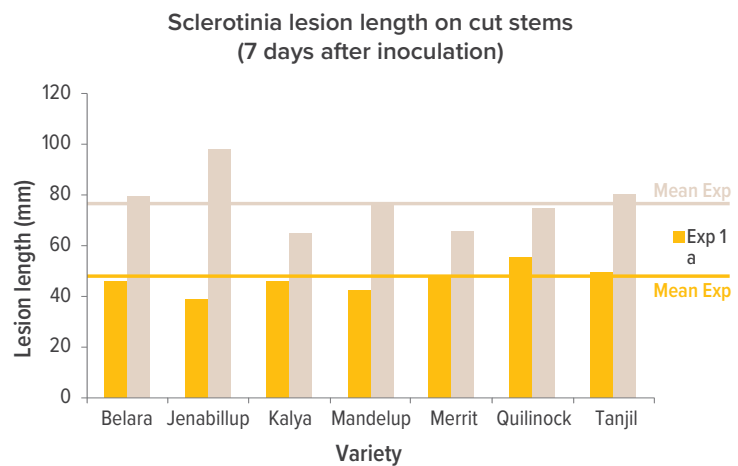
FEEDBACK

Primary risk factors for disease in susceptible areas include:

- » Presence of sclerotia in paddock or neighbouring paddock from previous sclerotinia infection in lupin or canola (or other broadleaf crops or pasture) in the past three or four years
- » Medium-high rainfall areas and/or seasons with wet springs
- » Densely growing crops on heavier soil types that maintain moisture longer and create a humid environment favoured by the pathogen³²

Trials have, to date, found no significant differences in lupin variety resistance to sclerotinia, as shown in Figure 4.³³

Figure 5: Sclerotinia lesion length on cut stems (7 days after inoculation).



(SOURCE: DAFWA)

32 DPIRD-GRDC (2016) MyCrop Diagnostic Tool – Diagnosing sclerotinia collar rot in narrow-leaved lupins, <https://www.agric.wa.gov.au/mycrop/diagnosing-sclerotinia-collar-rot-narrow-leaved-lupins>

33 Thomas, G, Beard, C (2015) Mingenew Irwin Group Presentation, <http://www.miq.org.au/author/zoe/page/3/>

FEEDBACK

8.8 Minor foliar diseases in WA lupin crops

Disease	Location	Symptoms	Management	Useful resources
Grey leaf spot (<i>Stemphylium botryosum</i>)	Leaves, stems, pods	Brown semi-circular or circular lesions/spots on leaves that can expand and become ash-grey. Brown 'pockmark' lesions on stems and pods. Premature or complete defoliation can occur.	Disease uncommon and rarely economically damaging in WA. Current varieties in WA carry effective genes for resistance.	https://www.agric.wa.gov.au/lupins/lupin-foliar-diseases-diagnosis-and-management
Cladosporium leaf spot (<i>Cladosporium sp.</i>)	Leaves, flowers	Dark grey circular spots on flowers and leaves.	Incidence and yield impact in WA rare. No specific control measures, except crop rotations.	https://www.agric.wa.gov.au/lupins/lupin-foliar-diseases-diagnosis-and-management
Grey mould (<i>Botrytis cinerea</i>)	Leaves, stems, pods	Lesions on flowers, stems and pods, grey fuzzy mould that may contain sclerotia. May be more common in albus than narrow leafed lupin.	Incidence and yield damage rare, no specific control measures except crop rotations.	https://www.agric.wa.gov.au/mycrop/diagnosing-grey-mould-narrow-leafed-lupins and https://www.agric.wa.gov.au/lupins/lupin-foliar-diseases-diagnosis-and-management
Powdery mildew (<i>Erysiphe polygoni</i>)	Leaves, stems, pods	White powdery growth on leaves, stems and pods.	Affects all species but serious crop damage has not been reported in WA. No specific management strategies needed, except crop rotations.	https://www.agric.wa.gov.au/lupins/lupin-foliar-diseases-diagnosis-and-management

(SOURCE: DAFWA)