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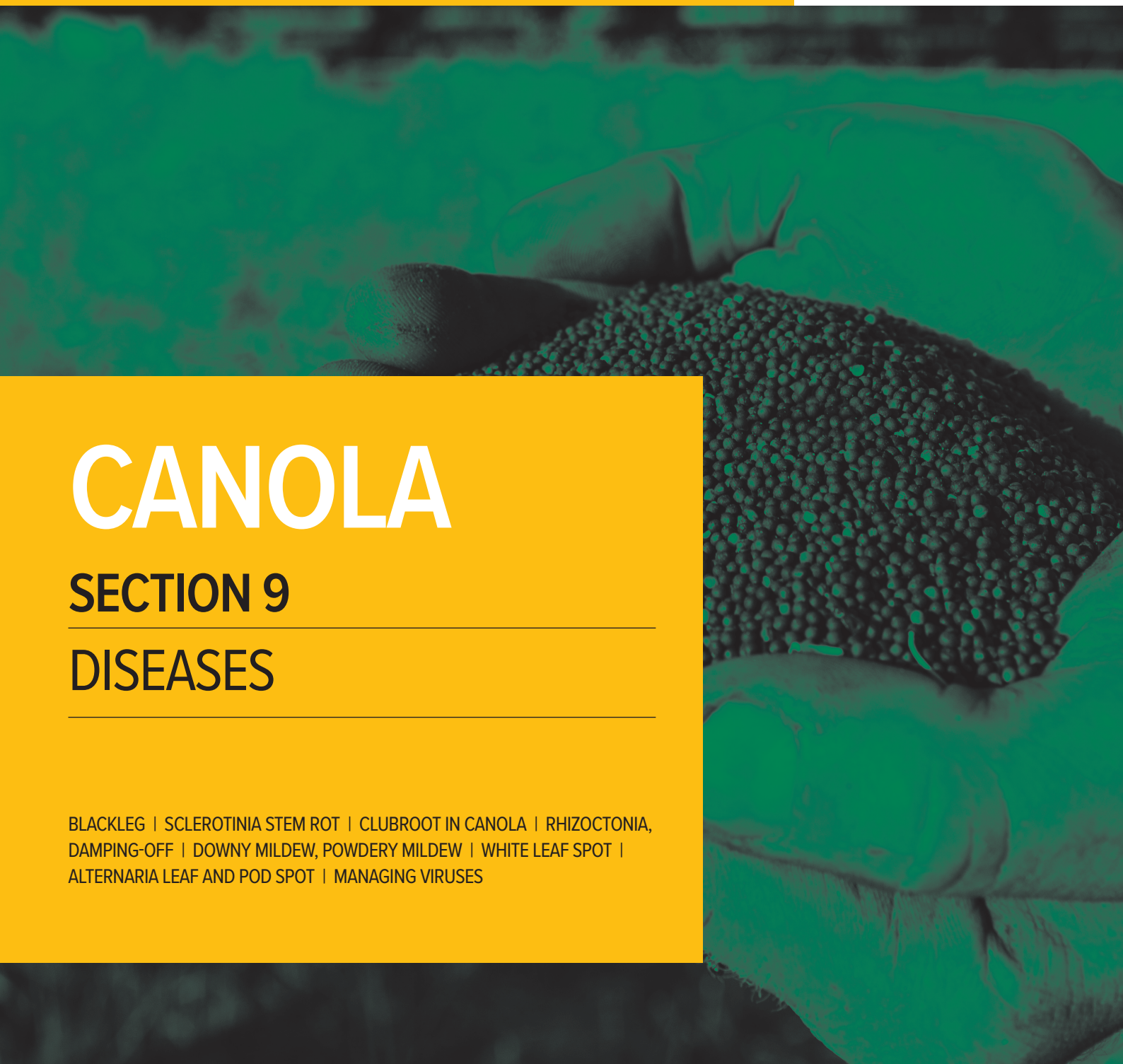

# CANOLA

## SECTION 9

## DISEASES

BLACKLEG | SCLEROTINIA STEM ROT | CLUBROOT IN CANOLA | RHIZOCTONIA, DAMPING-OFF | DOWNY MILDEW, POWDERY MILDEW | WHITE LEAF SPOT | ALTERNARIA LEAF AND POD SPOT | MANAGING VIRUSES

SECTION 9

# Diseases

Blackleg and Sclerotinia stem rot are the most economically important diseases (Table 1) in Western Australia (WA). Other foliar diseases are present but sporadic. Seasonal conditions play a major role in the occurrence of these diseases.

Club root has significance in the Northern Agricultural Region and requires constant vigilance.

*Table 1: Incidence of canola diseases in Western Australia*

| Disease | Occurrence |
|---|---|
| Blackleg | Very widespread |
| Sclerotinia stem rot | Common in Northern Agricultural Region and South Coast Region |
| Downy mildew | Isolated incidence in high-rainfall areas |
| White leaf spot | Common but low impact |
| **Section Club roxiiot** | Perceived risk to Northern Agricultural Region |
| Charcoal rot | Identified in Central Agricultural Region |
| *Beet western yellows virus* | Common and damaging |
| Root-lesion nematodes | Common and damaging? |

## 9.1 Blackleg

Blackleg is the most important disease of canola, and management of the disease need not be complex. The most effective strategies to reduce the severity of blackleg include growing varieties with an adequate level of resistance for the district, separating the present year's crop from last year's canola stubble by at least 500 m, and using a fungicide seed dressing or fungicide-amended fertiliser.

Typically, ~90% of spores that infect new-season crops originate from the previous year's stubble. However, significant numbers of spores from 2-year-old stubble may be produced if seasonal conditions have been dry or the stubble is still largely intact. Spores can travel 1–2 km on the wind, but most originate more locally. A buffer distance of at least 500 m and up to 1 km is recommended. Use of fungicide seed dressings containing fluquinconazole or fertiliser treated with flutriafol will also assist in minimising the effects of blackleg and protect seedlings from early infection, which later causes stem canker development. Although raking and burning can reduce canola stubble by up to 60%, it is the least effective strategy in managing blackleg and is therefore not generally recommended. [1]

**More information**

Research paper: Dynamics of fungal diseases of canola in Western Australia

GRDC Ground Cover: Foliar fungal diseases of pulses and oilseeds

GRDC Update Papers: Viral diseases in canola and winter pulses

Canola diseases. The Back Pocket Guide

GRDC Update Papers: Blackleg pod infection, resistance group monitoring and sclerotinia

GRDC Update Papers: Canola and pulse management; maintaining the vigilance

[1] P Matthews, D McCaffery, L Jenkins (2015) Winter crop variety sowing guide 2015. NSW DPI Management Guide. NSW Department of Primary Industries, http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0011/272945/winter-crop-variety-sowing-guide-2015.pdf


Canola growers are urged to consult the latest Blackleg Sporacle model from the Department of Agriculture and Food Western Australia (DAFWA) to determine what action they may need to take to protect their crop from this potentially devastating disease. [2]

The Blackleg Sporacle model was developed by the department with the support of GRDC, and is based on 4 years of epidemiology research on the timing of maturity of fruiting bodies and the spore release pattern throughout the wheatbelt.

According to a GRDC report, blackleg has the potential to cost the WA canola industry >$175 million per annum if not controlled. Presently, the estimated annual cost of blackleg is nearly $60 million. [3]

All current canola varieties are now assessed for the presence of resistance genes and classified into resistance groups. If the same variety has been grown for two or more seasons, consider changing varieties for this season. Consult the Blackleg management guide, autumn 2015 Fact Sheet to determine the resistance group for your current canola varieties and select future varieties that belong to a different group. [4]

Summary:

- Monitor your crops to determine yield losses in the current crop.
- Choose a cultivar with adequate blackleg resistance for your region.
- Never sow a canola crop into last year's canola stubble.
- Reliance solely on fungicides to control blackleg poses a high risk of fungicide resistance.
- If your monitoring has identified yield loss and you have grown the same cultivar for ≥3 years, choose a cultivar from a different resistance group.

## More information

DAFWA Crop Disease Forecast

Research paper: Chemical control of blackleg disease of canola in Western Australia

[2] DAFWA (2015) Blackleg Sporacle gazes into disease risk. Department of Agriculture and food Western Australia, https://www.agric.wa.gov.au/news/media-releases/blackleg-sporacle-gazes-disease-risk

[3] DAFWA (2015) Blackleg Sporacle gazes into disease risk. Department of Agriculture and food Western Australia, https://www.agric.wa.gov.au/news/media-releases/blackleg-sporacle-gazes-disease-risk

[4] P Matthews, D McCaffery, L Jenkins (2015) Winter crop variety sowing guide 2015. NSW DPI Management Guide. NSW Department of Primary Industries, http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0011/272945/winter-crop-variety-sowing-guide-2015.pdf

### 9.1.1 Four steps to beating blackleg

*Step 1. Determine your farm's risk*

Use Table 2 to determine your farm's blackleg risk. Combined high canola intensity and adequate rainfall increase the probability of severe blackleg infection.

*Table 2: Regional environmental factors that determine risk of severe blackleg infection*

| Environmental factors | Blackleg severity risk factor | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | High risk | | | Medium risk | | | Low risk | | |
| Regional canola intensity (% area sown to canola | >20 | 16–20 | 15 | 11–14 | 11–14 | 10 | 6–9 | 5 | <5 |
| Annual rainfall (mm) | >600 | 551–600 | 501–550 | 451–500 | 401–450 | 351–400 | 301–350 | 251–300 | <250 |
| Total rainfall March–May prior to sowing (mm) | >100 | >100 | >100 | >100 | 91–100 | 81–90 | 71–80 | 61–70 | <60 |

**More information**

GRDC: Blackleg management guide, autumn 2015 Fact Sheet

GRDC Media: GRDC funding canola stubble screening for fungicide-tolerant blackleg

GRDC: Revised spring blackleg management guide Fact Sheet

Managing blackleg and sclerotinia in canola. The Back Pocket Guide

GRDC Ground Cover Supplement: Optimising canola profitability

Oilseeds WA: Assessment of fungicide efficacy against blackleg disease

MFMG: Investigating Fungicide Best Practice Management

*Step 2. Determine each crop's blackleg severity in spring*

- Assess the level of disease in your current crop. Sample the crop any time from the end of flowering to windrowing (swathing). Pull 60 randomly chosen stalks out of the ground, cut off the roots with a pair of secateurs and, using the reference photos in Figure 1 below, estimate the amount of disease in the stem cross-section. Yield loss occurs when more than half of the cross-section is discoloured.
- A dark-coloured stem is a symptom of blackleg (Figure 1). Stem cankers are clearly visible at the crown of the plant. Severe cankers may cause the plant to fall over as the roots become separated from the stem.

If you have identified that you are in a high-risk situation (steps 1 and 2), use steps 3 and 4 below to reduce your risk of blackleg for future seasons.

If you are in a low-risk situation and you have not identified yield loss due to blackleg infection when you assessed your crop, continue with your current management practices.

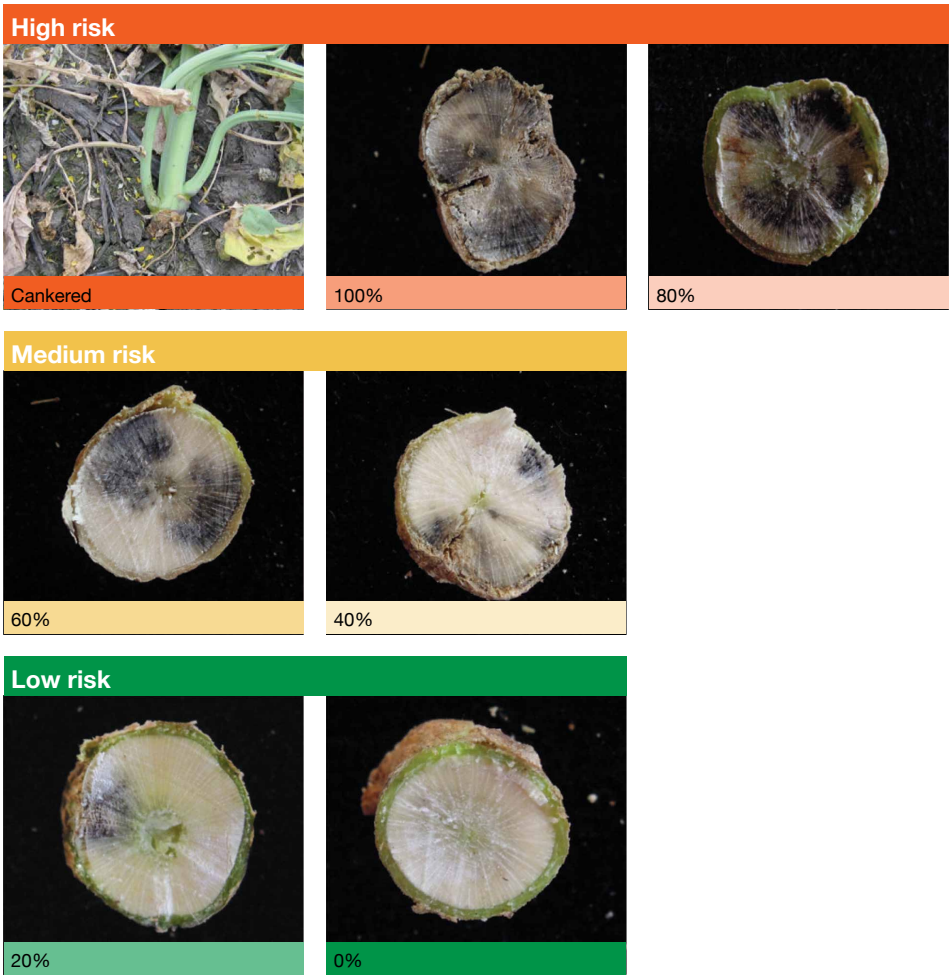


*Figure 1: Crop blackleg severity.*

### *Step 3. Management practices can reduce the risk of blackleg infection*

If your crop monitoring (see step 2) showed yield loss in the previous year, the following practices can be used to reduce blackleg severity. Complete the following process for each canola paddock to be sown.

- For each of the management factors listed in Table 3 below (and in the Blackleg risk management worksheet accompanying the Blackleg management guide, autumn 2015 Fact Sheet), circle where each canola paddock fits to determine the risk of blackleg. For example, for 'blackleg rating', if your cultivar is ATR-Stingray, circle 'MR', indicating a low risk of blackleg; or for 'distance from last year's canola stubble', if your proposed canola crop is 200 m away, high risk is indicated.
- Complete all management factors to determine which practices are causing increased risk and how they can be reduced. For example, for 'distance from last year's canola stubble', choose a different paddock, at least 500 m away from last year's stubble, reducing the risk from high to low.

*Table 3: Management factors used to determine which practices are increasing the risk of blackleg infection*

*For blackleg rating of cultivar: VS, very susceptible; S, susceptible; MS, moderately susceptible; MR, moderately resistant; R, resistant; see text below (Blackleg rating) for further details*

| Blackleg rating of cultivar | VS | S–VS | S | MS–S | MS | MR–MS | MR | MR–R | R |
|---|---|---|---|---|---|---|---|---|---|
| Distance from last year's canola stubble | 0 m | 100 m | 200 m | 300 m | 400 m | 500 m | >500 m | >500 m | >500 m |
| Fungicide use | No fungicide | | Foliar applied fungicide | | Seed dressing fungicide | Fertiliser applied fungicide | Seed dressing + fertiliser applied fungicide | Seed dressing or fertiliser applied + foliar fungicide | Seed dressing or fertiliser applied + foliar fungicide |
| Years of same cultivar grown | Same cv. or resistance group for >3 years | | | Same cv. or resistance group for 3 years | | | Same cv. or resistance group for 2 years | Same cv. or resistance group for 2 years | Same cv. or resistance group for 2 years |
| Distance from 2-year-old canola stubble | | | | | 0 m | 100 m | 250 m | 250 m | 250 m |
| Canola stubble conservation | | | | Inter-row sowing | Disc tillage | Knife-point tillage | Burning or burying tillage | Burning or burying tillage | Burning or burying tillage |
| Month sown | | | | June–Aug. | 15–31 May | 1–14 May | 15–30 April | 15–30 April | 15–30 April |
| Dual purpose grazing canola | | | | | Grazing canola | | | | |

### *Step 4. Blackleg resistance groups*

Canola cultivars have different combinations of blackleg resistance genes. Over time, growing cultivars with the same blackleg resistance genes has led to changes in the virulence of the blackleg pathogen, which has enabled it to overcome cultivar resistance. By rotating between cultivars with different resistance genes, you can reduce the probability of resistance breakdown and reduce disease severity.

Based on steps 1–3, are you in a high-risk region or have you observed increasing blackleg severity and grown the same cultivar in close proximity for ≥3 years?

- No. Your current management practices should be sufficient to manage blackleg resistance adequately.
- Yes. You may be at risk of the blackleg fungus overcoming the blackleg resistance of your cultivar. It is recommended that you grow a cultivar with a different combination of blackleg-resistance genes (see table 3 in Blackleg management guide, autumn 2015 Fact Sheet). You do not need to change resistance groups (cultivars) every year. [5]

[5] GRDC (2015) Blackleg management guide, autumn 2015. GRDC Fact Sheet, 29 April 2015, http://www.grdc.com.au/GRDC-FS-BlacklegManagementGuide

### 9.1.2 Blackleg rating

Practices to deal with the breakdown of blackleg resistance in intensive canola districts are based on large screening trials. Industry understanding of the blackleg pathogen of canola has progressed substantially over the past few years. An important practical development from this work is that all current commercial cultivars and advanced breeding lines have been screened to determine their complement of blackleg resistance genes. This has enabled researchers to allocate cultivars into one of seven resistance groups.

Growers are familiar with the rating of crop varieties for susceptibility (S) through to resistance (R) to a specific pathogen. However, the sexually reproducing pathogen blackleg is adept at overcoming cultivar resistance, and this compromises a cultivar's blackleg rating. Field observations have found that blackleg resistance is often overcome when the same variety is regularly grown across large areas in a region for >3 years.

Seven resistance rotation groups have been established (named A–G). If there is a risk of high blackleg severity in a location where the same cultivar has been grown for ≥3 years, then a cultivar from a different resistance group needs to be sown (see Blackleg management guide Fact Sheet).

One canola cultivar from each of the seven resistance groups has been sown adjacent to National Variety Trials (NVT) sites to monitor how blackleg populations evolve to overcome cultivar resistance. In 2011, this blackleg monitoring identified regional differences in infection levels between resistance groups. This information was used as the basis of a pre-sowing, early-warning system to alert growers in a region to the potentially high level of blackleg inoculum able to attack cultivars in a specific resistance group.

There are 32 blackleg-monitoring sites across Australia in WA, New South Wales, South Australia and Victoria. [6]

All varieties are rated according to the independent Australian National Blackleg Resistance rating system, in which all canola-breeding companies are participants. The ratings, based on relative differences between varieties, are as follows:

- resistant: R
- resistant to moderately resistant: R–MR
- moderately resistant: MR
- moderately resistant to moderately susceptible: MR–MS
- moderately susceptible: MS
- moderately susceptible to susceptible: MS–S
- susceptible: S
- susceptible to very susceptible: S–VS
- very susceptible: VS

[6] GRDC (2014) 2014—Revised blackleg spring management guide. GRDC Ground Cover Issue 101, http://grdc.com.au/Media-Centre/Ground-Cover-Supplements/GCS101/Advances-in-blackleg-management

**More information**

eXtensionAUS: Blackleg monitoring sites

GRDC Update papers: eXtensionAUS (Southern region)

Varieties with a rating of 'resistant' (R) in areas of high blackleg risk and at least 'moderately resistant' (MR) in areas of lower blackleg risk will normally give sufficient disease protection. [7] The blackleg-resistance ratings for all varieties for 2015 are available in the Blackleg management guide, autumn 2015 Fact Sheet (see table 3 therein). [8]

## 9.2 Sclerotinia stem rot

Sclerotinia stem rot is a fungal disease that can infect a wide range of broadleaf plants, including canola. Disease development is favoured by prolonged wet conditions in late winter followed by periods of prolonged leaf wetness during flowering.

Yield losses range from nil to 20% in some years, but losses have been as high as 35%. Districts with reliable spring rainfall and long flowering periods for canola appear to develop the disease more frequently. Continual wheat–canola rotations are also very effective at building up levels of soil-borne sclerotia.

Burning canola stubble will not control the disease effectively, because *Sclerotinia* survives mainly on or in the soil. Crop rotation with cereals, following recommended sowing times and ensuring that crops do not develop heavy vegetative growth, which is likely to reduce air circulation, are the best means of reducing the impact of the disease.

The inconsistent relationship between the level of stem infection and yield loss makes it difficult to predict an economic response from using foliar fungicides in any one year. The specific environmental conditions for development of Sclerotinia stem rot will not occur every year. For example, in dry conditions, even if the fungus is present, the disease may fail to develop.

The fungicide Prosaro® (active ingredients prothioconazole + tebuconazole), and iprodione and some procymidone products, are registered for the management of Sclerotinia stem rot.

Consult your farm adviser and refer to the Sclerotinia stem rot in canola Fact Sheet. [9]

Key points for managing Sclerotinia stem rot:

- An outbreak of Sclerotinia stem rot is highly dependent on the season.
- Prolonged wet or humid conditions during flowering favour the disease.
- Consider past outbreaks of the disease as a guide to potential yield loss.

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7 P Matthews, D McCaffery, L Jenkins (2015) Winter crop variety sowing guide 2015. NSW DPI Management Guide. NSW Department of Primary Industries, http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0011/272945/winter-crop-variety-sowing-guide-2015.pdf

8 GRDC (2015) Blackleg management guide, autumn 2015. GRDC Fact Sheet, 29 April 2015, http://www.grdc.com.au/GRDC-FS-BlacklegManagementGuide

9 P Matthews, D McCaffery, L Jenkins (2015) Winter crop variety sowing guide 2015. NSW DPI Management Guide. NSW Department of Primary Industries, http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0011/272945/winter-crop-variety-sowing-guide-2015.pdf

**More information**

GRDC: Sclerotinia stem rot in canola Fact Sheet

Canola diseases. The Back Pocket Guide

GRDC Update Papers: Canola disease update 2015 (NSW)

AOF: Economics and timing of fungicide application to control Sclerotinia stem rot in canola

GRDC Media: Tips and tools for managing Sclerotinia in 2015

- Avoid growing canola in paddocks with a history of Sclerotinia stem rot over the past 4 years, or in adjacent paddocks.
- Well-timed fungicide treatments, when canola crops are at 20–30% flowering stage, can be highly effective in reducing the level of infection.
- No Australian canola varieties have known resistance to the disease.[10]

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### 9.2.1 Managing Sclerotinia stem rot in canola in Western Australia

Sclerotinia stem rot is one of the most variable and unpredictable diseases of canola, and incidence of infection can vary greatly between paddocks and between years. Yield losses can be severe in years of higher moisture, with losses exceeding 20% under conducive conditions. Cool temperatures and prolonged precipitation are ideal conditions for its development.

Rotation, tillage and fungicides are currently the best strategies for managing Sclerotinia stem rot, including:

- long rotation
- rotate with non-host crops
- avoiding sowing close to last year's infected crop
- use of clean seed
- use of foliar fungicide[11]

#### *Rotation*

Crop rotation can help in reducing disease severity. Leave canola out of the rotation for as long as possible (at least 3 years) to allow Sclerotia to decompose, thus reducing the risk of subsequent infections. Include in rotations species that are unaffected by *Sclerotinia*, such as cereals. Leave out species such as lupins, chickpeas and lentils, which are very susceptible. Windborne spores may be blown a great distance into susceptible crops. Separate canola crops by ≥100 m from paddocks that had conspicuous levels of Sclerotinia stem rot in the previous year.[12]

#### *Symptoms*

*Sclerotinia* can infect any part of the plant (Figure 2). Symptoms appear as bleached greyish white or brownish white fungal growth covering portions of the canola stem, sometimes just above soil level but also at any height in the canopy (Figure 3). After

[10] GRDC (2014) Canola disease management in the northern region. GRDC Ground Cover, 21 March 2014, http://grdc.com.au/Media-Centre/Hot-Topics/Canola-disease-management-in-the-northern-region

[11] R Khangura, C Beard (2015) Managing sclerotinia stem rot in canola, Department of Agriculture and Food Western Australia, https://www.agric.wa.gov.au/canola/managing-sclerotinia-stem-rot-canola?page=0%2C1

[12] R.Khangura ,C. Beard (2015) Managing sclerotinia stem rot in canola, Department of Agriculture and Food Western Australia, https://www.agric.wa.gov.au/canola/managing-sclerotinia-stem-rot-canola?page=0%2C1

infection is well established, the disease causes plants to wilt and ripen prematurely (Figure 4), resulting in lodging and reduced seed production (Figures 5 and 6).

*Figure 2: Sclerotinia leaf lesions can appear as watermarks on canola leaves. (Photo: DAFWA)*

*Figure 3: Early stem lesion appearing as a bleached oval area, indicating Sclerotinia stem rot in canola. (Photo: DAFWA)*

*Figure 4: Bleached canola stem indicative of Sclerotinia. Infected canola stems stand out as looking bleached and maturing early amidst healthy plants. (Photo: DAFWA)*

*Figure 5: Stem bleaching, rotting and lodging due to Sclerotinia stem rot in canola. (Photo: DAFWA)*

*Figure 6: Infected stems are weak and can lodge. (Photo: DAFWA)*

Advanced infection will have hard, black, generally irregular-shaped to rounded bodies (sclerotia) on the inside of the affected and bleached parts of the stem. Stems can be carefully split to observe the black sclerotia within (Figure 7). The sclerotia, which are >2 mm in diameter, are the survival structure of the fungus. They appear like rat droppings. In moist weather, they can also form on the outside of the infected stem or roots (Figure 8). If the weather is favourable, canola pods also may become infected. Infected pods appear creamish white in colour and usually contain white, mouldy seeds (Figure 9). In some instances, these seeds are replaced by sclerotia, which contaminate harvested seed samples. Further information on diagnosis is available at MyCrop—Diagnosing Sclerotinia stem rot in canola. Samples can be submitted for definitive diagnosis to AGWEST Plant laboratories (this is a chargeable service).[13]

*Figure 7: Canola crop inspection includes breaking open the bleached stem. This may reveal black sclerotia, the resting phase of the fungus. (Photo: DAFWA)*

[13] R.Khangura ,C. Beard (2015) Managing sclerotinia stem rot in canola, Department of Agriculture and Food Western Australia, https://www.agric.wa.gov.au/canola/managing-sclerotinia-stem-rot-canola?page=0%2C1

*Figure 8: Severe infection on stem showing fluffy white fungal growth and sclerotia. (Photo: DAFWA)*

*Figure 9: Sclerotinia infection causes creamish white pods that usually contain white mouldy seeds. (Photo: DAFWA)*

## *Assessment of Sclerotinia risk*

Risk factors for Sclerotinia stem rot infection include:

- paddock history
- rotation with susceptible crops
- disease incidence in the last affected crop
- distance from last affected crop
- rain events during flowering

For disease to occur, sclerotia or spores must be present to initiate infection. However, the sclerotia can survive for ≥6 years in the soil, so risk persists for several years.

A canola crop is considered at risk of developing Sclerotinia stem rot if:

- Sclerotinia has been present within the past 3 years in the paddock or an adjacent paddock.
- An intensive rotation with other broadleaf crop species has been followed. For example, if a canola or susceptible crop has been grown in the past 2 years, then the risk is high compared with a paddock where only cereals have been grown for the past 5 years.

The over-riding determinant of the severity of Sclerotinia stem rot that develops in a crop is the weather during flowering on the primary stem. Moisture in the crop canopy is required for infection to occur and develop into stem rot. This usually results from frequent rain events of ≥5 mm. Infrequent rain or light showers are unlikely to result in sufficient canopy wetness for yield-limiting infections to occur. [14]

### *Cause and disease cycle*

Sclerotinia stem rot is caused by the fungus *Sclerotinia sclerotiorum*. It survives as sclerotia in the soil for many years. The fungus may also survive by colonising other host plants, such as wild radish and cape weed. During cool, moist weather, sclerotia in the soil germinate and produce small, cream-coloured, mushroom-like bodies (apothecia). These grow to ~5 mm in diameter and become darker coloured as they age (Figure 10).

[14] R.Khangura ,C. Beard (2015) Managing sclerotinia stem rot in canola, Department of Agriculture and Food Western Australia, https://www.agric.wa.gov.au/canola/managing-sclerotinia-stem-rot-canola?page=0%2C1

*Figure 10: Healthy, young apothecia of Sclerotinia look like tiny white mushrooms (top); over time they age and dehydrate and turn brown (bottom). (Photos: DAFWA)*

These apothecia contain large numbers of ascospores, which become airborne and blow to nearby crop plants. Although the spores rarely infect healthy stems and leaves directly, they readily infect canola petals (Figure 11). The fungus infects stems and leaves when infected petals fall and stick to leaf axils, and the fungus invades healthy plant tissue using the infected petal as a food source. Cool, wet weather favours the disease, and mist, dew and fog provide enough moisture for infection.

Sclerotia resting in the soil can also germinate to produce hyphae or mycelia, which can penetrate the stem base of a nearby canola plant and cause basal stem infection. However, direct germination of sclerotia is not a common cause of infection in canola. [15]

[15] R.Khangura ,C. Beard (2015) Managing sclerotinia stem rot in canola, Department of Agriculture and Food Western Australia, https://www.agric.wa.gov.au/canola/managing-sclerotinia-stem-rot-canola?page=0%2C1

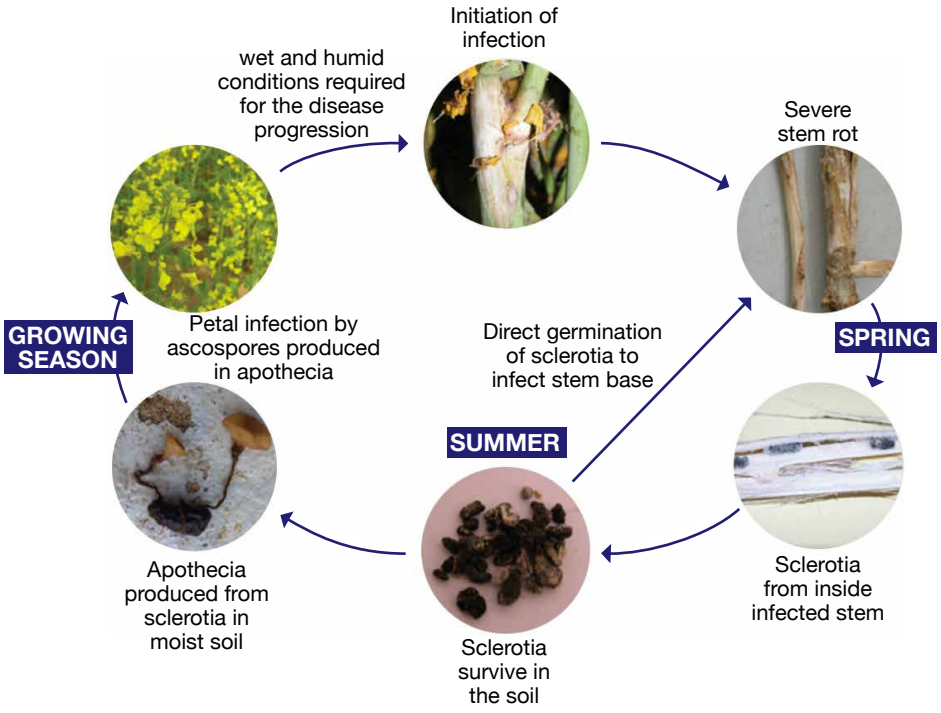


*Figure 11: Lifecycle of Sclerotinia in canola.*

## Hosts

*Sclerotinia sclerotiorum* has a wide host range including >400 different plant species. It infects most of the broadleaf crops. Among these, lupins and chickpeas are commonly infected, whereas faba beans and field peas appear to be less susceptible. Broadleaf weeds such as wild radish and cape weed are also hosts and play a role in carryover of the fungus.[16]

## Tillage

Mouldboard ploughing of infected stubble may reduce carryover to subsequent crops, because deep burial (below 15 cm) limits germination of sclerotia and development of apothecia. Most sclerotia germinate if they are close to the soil surface (within 2–3 cm) but may survive for ≥5 years when buried at greater depths. However, deep burial is only effective if deep tillage is not used in the following years, to ensure that sclerotia are not brought back to the soil surface later. Hence, management with tillage is uncertain.[17]

## Fungicides

The decision to spray should be based on:

- presence of inoculum (previous Sclerotinia infections in paddock or nearby, sightings of apothecia in area)
- favourable conditions for the development of fungus

[16] R.Khangura ,C. Beard (2015) Managing sclerotinia stem rot in canola, Department of Agriculture and Food Western Australia, https://www.agric.wa.gov.au/canola/managing-sclerotinia-stem-rot-canola?page=0%2C1

[17] R Khangura, C Beard (2015) Managing sclerotinia stem rot in canola, Department of Agriculture and Food Western Australia, https://www.agric.wa.gov.au/canola/managing-sclerotinia-stem-rot-canola?page=0%2C1

- crop growth stage (see below, *Assessment of flowering stages in canola*)
- frequent showers during flowering
- yield potential

Always use fungicides according to the product label.

*Timing of fungicide application:*

The timing of fungicide application is extremely important for the effective control of this disease. Trial data from WA suggest that in the case of early onset of disease, early applications at 15–30% bloom may give excellent control of the disease, whereas late applications (40–50% bloom) may be too late. However, an economic response from late applications may be achieved if disease epidemics start late in the season (as occurred in many areas in 2013 with a wet spring). On average in most seasons, application at 20–30% bloom may be a good strategy if only one fungicide spray is to be applied, but research is ongoing on this timing.

If there has been an early application (10–20% bloom) and the forecast is for a wet spring, which will favour the disease, then a second application may be required at ~40–50% bloom. However, the decision on whether to spray is determined by the disease risk, the current price of canola and the yield potential of the crop. Application before 10% flowering (10 flowers open on main stem) is not recommended. *Sclerotinia* infection and spread requires moist conditions, so if it is dry, disease progression in the crop will slow. Hence, being flexible and monitoring future rainfall patterns is important in the timing of fungicide application. Application close to the next rainfall event is a good strategy.

See *Current research* below for discussion of the economics of fungicide application. [18]

*Registered fungicides*

Table 4 provides information on the foliar fungicides currently registered in WA for controlling Sclerotinia stem rot in canola.

*Table 4: Chemicals currently registered for use as foliar fungicides in Western Australia, their application rates and trade names*

| Active chemical | Rate | Trade name |
|---|---|---|
| Iprodione | 2 L/ha | Rovral® Liquid, Chief® 250, Iprodione Liquid 250, Corvette® Liquid, Civet® Liquid, Deathcap 250, Ipral 250, Iprodex 250, Flex GT 250, Shelby 250 |
| Procymidone | 1 L/ha | Fortress®, Procymidone 500, Sumisclex® 500, Sumisclex® Broadacre |
| Prothioconazole + tebuconazole | 375–450 mL/ha | Prosaro® 420 SC |

The Registered foliar fungicides for canola in WA shows current registrations for both *Sclerotinia* and blackleg.

[18] R Khangura, C Beard (2015) Managing sclerotinia stem rot in canola, Department of Agriculture and Food Western Australia, https://www.agric.wa.gov.au/canola/managing-sclerotinia-stem-rot-canola?page=0%2C1

### *Varieties*

All current commercial canola varieties are considered to have low resistance to *Sclerotinia*. However, some varieties may be less susceptible than others. Late-flowering varieties may escape infection provided their flowering window does not coincide with spore release or extended humid weather conditions. Sow only good-quality seed that is free of sclerotia.

### *Assessment of flowering stages in canola*

Flowering (bloom) stages in canola can be difficult to determine, so a standard method of assessing them is provided here. Correct determination of flowering stages will enable fungicides to be applied at the right time.

Flowering stage should be assessed on the main stem:

- 10% bloom, 10 flowers open on main stem
- 20% bloom, 14–16 flowers open on main stem
- 30% bloom, ≥20 flowers open on main stem
- 40% bloom, ≥30 flowers open on main stem
- 50% bloom, all flowers are open or have opened, crop is at its most intense yellow (full flower)
- 60% bloom, flowering intensity is beginning to decline

### *Current research*

Currently, DAFWA is undertaking research in the following areas in relation to Sclerotinia stem rot:

- *Sclerotinia* surveys
- epidemiology (petal testing, spore trapping and research with sclerotia to understand the disease lifecycle)
- timing of fungicide application, and investigating non-chemical measures for control
- effect of flowering time on *Sclerotinia* development
- screening for resistance under controlled environment
- development of a *Sclerotinia* risk-forecasting tool based on WA conditions

See the GIWA 2013 Crop Updates paper: Why Sclerotinia was so bad in 2013—Understanding the disease and management options.

### *Incidence in Western Australia*

Survey results have shown high incidence of Sclerotinia stem rot across canola crops in WA in 2008, 2009, 2011 and 2013, with significantly higher incidence in the Northern Agricultural Region in all years except 2013 (Figure 12). This does not mean that the disease cannot be a problem in southern areas of the state. Survey results of 71 crops in the Southern Agricultural Region in 2009 showed >20% exhibiting symptoms of Sclerotinia stem rot, and in four worst affected crops, the incidence ranged between 69% and 80% (Figure 13). In addition, in 2013, incidence was relatively high in the Southern Agricultural Region.

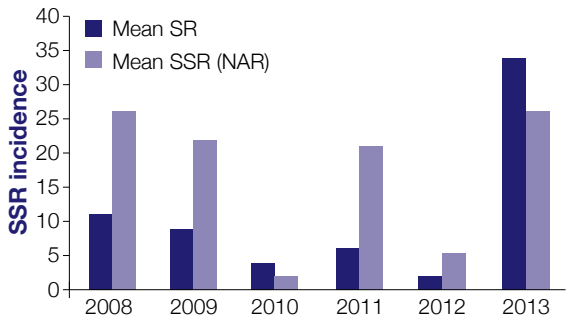


*Figure 12: Sclerotinia stem rot (SSR) incidence in Western Australia (2008–13), including the Northern Agricultural Region (NAR).*

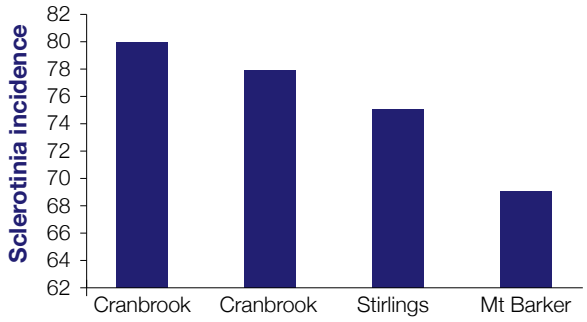


*Figure 13: Survey results assessing the prevalence of Sclerotinia stem rot in four crops in the Southern Agriculture Region of Western Australia.*

## *Variety resistance*

Why is it so difficult to breed canola varieties with resistance to Sclerotinia stem rot?

- lack of reliable screening techniques
- challenges in screening lines under field conditions
- pathogen variability

## *Efficacy and economics of fungicide applications*

Research has shown that treatment with fungicides improved the percentage disease index by a significant level, and grain yields have shown significant improvements compared with untreated controls. The economics of these treatments, however, is largely dependent on the cost of fungicide applied; the more expensive fungicides do not improve yields enough to recoup application costs. Tables 5 and 6 provide an indication of the economics of fungicide applications.[19] [20]

[19] https://www.agric.wa.gov.au/canola/managing-sclerotinia-stem-rot-canola?page=0%2C1

[20] R Khangura, B MacLeod. **Managing the risk of Sclerotinia stem rot in canola.** WA Farmnote 546, Department of Agriculture and Food Western Australia.

*Cost return tables*

*Table 5: Return on fungicide application ($/ha) for a range of crop yield potentials and expected yield response when a single application of fungicide is made by plane ($15/ha) for a total cost of $41/ha, with canola price $500/t*

| Yield response | Crop yield (t/ha) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 0.7 | 1.0 | 1.2 | 1.5 | 1.8 | 2.0 | 2.2 | 2.5 |
| 0 | –41 | –41 | –41 | –41 | –41 | –41 | –41 | –41 |
| +5 | –24 | –16 | –11 | –3 | 4 | 9 | 14 | 22 |
| +10 | -6 | 9 | 19 | 34 | 49 | 59 | 69 | 84 |
| +15 | 11 | 34 | 49 | 71 | 94 | 109 | 124 | 147 |
| +20 | 29 | 59 | 79 | 109 | 139 | 159 | 179 | 209 |
| +25 | 47 | 84 | 109 | 147 | 184 | 209 | 234 | 272 |
| +30 | 64 | 109 | 139 | 184 | 229 | 259 | 289 | 334 |
| +35 | 82 | 134 | 169 | 222 | 274 | 309 | 344 | 397 |
| +40 | 99 | 159 | 199 | 259 | 319 | 359 | 399 | 459 |

*Table 6: Return on fungicide application ($/ha) for a range of crop yield potentials and expected yield response when a single application of fungicide is made by self-propelled boomspray ($5/ha) for a total cost of $31/ha, with canola price $500/t*

| Yield response (%) | Crop yield (t/ha) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 0.7 | 1.0 | 1.2 | 1.5 | 1.8 | 2.0 | 2.2 | 2.5 |
| 0 | –31 | –31 | –31 | –31 | –31 | –31 | –31 | –31 |
| +5 | –14 | –6 | –1 | 7 | 14 | 19 | 24 | 32 |
| +10 | 4 | 19 | 29 | 44 | 59 | 69 | 79 | 94 |
| +15 | 21 | 44 | 59 | 81 | 104 | 119 | 134 | 157 |
| +20 | 39 | 69 | 89 | 119 | 149 | 169 | 189 | 219 |
| +25 | 57 | 94 | 119 | 157 | 194 | 219 | 244 | 282 |
| +30 | 74 | 119 | 149 | 194 | 239 | 269 | 299 | 344 |
| +35 | 92 | 144 | 179 | 232 | 284 | 319 | 354 | 407 |
| +40 | 109 | 169 | 209 | 269 | 329 | 369 | 409 | 469 |

## 9.3 Clubroot in canola

Clubroot is caused by the soilborne fungus *Plasmodiophora brassicae* and is not considered common or a serious risk. It has generally been found in the northern canola-growing regions of WA. DAFWA surveys in 2008–10 found that the average incidence of this disease in northern areas ranged from 7% to 25%. Conditions in southern areas were dry in that period and no incidence was recorded.

A 2013 survey of canola by DAFWA found mild levels of clubroot in one sample from the southern region; however, the Stirling to Coast grower group found no incidence in that region in the latest season.

Good machinery hygiene practices between paddocks and properties and longer canola rotations of up to 5 years can prevent spread where present.

## 9.4 *Rhizoctonia*, damping-off

Damping-off in canola is caused by a complex of *Rhizoctonia*, *Fusarium* and *Pythium* species. *Rhizoctonia* affects a wide range of crops, including canola. It and has

become more prevalent, particularly in cereals, across WA in recent years in the wake of minimum-tillage practices that provide a habitat for the fungus during summer.

Damping-off and hypocotyl rot of oilseeds and legumes are all caused by different strains of *Rhizoctonia solani*. Affected seedlings fail to emerge, or collapse at ground level in patches. These diseases occur when conditions are unfavourable for germination and early seedling growth.

However, yield loss is unusual unless plant numbers are severely reduced or there is patchy establishment. Dry-sown crops are more at risk, but if crops are re-sown, soil tillage will generally control the fungi.

Seed fungicide treatments such as Maxim® XL or Apron® at sowing can also reduce damage caused by *Rhizoctonia* and/or *Pythium*. See your agronomist and/or www.apvma.gov.au.

## 9.5 Downy mildew, powdery mildew

Surveys by DAFWA in 2008–10 found high levels of powdery mildew in canola in 2008. The impact of this disease on the state's oilseed crops is not known, and it is not considered a high risk.

Downy mildew is very common in canola crops across Australia, but it is rarely found after the vegetative stage and it tends to have little effect on crop performance.

## 9.6 White leaf spot

White leaf spot is more common in wetter years. The disease is generally present on leaves of young canola plants; however, with prolonged wet weather, it continues to progress up in the canopy and can affect stems and pods during flowering.

White leaf spot is not generally considered serious unless pods are affected. Some yield loss can be expected if leaf lesions join and cause premature defoliation.

White leaf spot can be managed through rotations and cultural practices. Currently, no fungicides are registered for the control of white leaf spot.

## 9.7 Alternaria leaf and pod spot

Leaf and pod infection by *Alternaria* was generally considered to occur sporadically in WA, until 2013, when many crops across the state were found to have infection on the pods. Pod infection can result in heavy seed infection, and sowing *Alternaria*-infected seed can cause seedling blight.

Moderate temperatures and frequent rainfall during spring favour this disease. Disease is both seed- and stubble-borne and can be managed by sowing clean seed and avoiding sowing close to infected residues. No fungicides are registered for the control of *Alternaria* in canola.

## 9.8 Managing viruses

Management of viruses centres on implementing best agronomic practice:

- Retain standing stubble to deter migrant aphids from landing.
- Sow at the optimal seeding rate and sowing time, because earlier sown crops are more prone to aphid attack.
- Control in-crop and fallow weeds to remove the in-crop and nearby sources of virus infection. [21]

*Beet western yellows virus* (BWYV) is a persistently transmitted virus that infects a wide range of crops and weeds. Its main vector is the green peach aphid (*Myzus persicae*).

Virus-control strategies should be based on preventing infection, because infected plants cannot be cured. Preventive measures to avoid BWYV infection in canola include seed treatment with systemic insecticides that are effective for green peach aphid control and sowing in standing wheat stubble. [22]

### *What to look for*

#### *Paddock*

Discoloured, sometimes stunted plants occur in patches, in thinner crop areas or the edge of the paddock, and gradually spread.

#### *Plant*

- First signs are red, yellow or purple colours at the ends or edges of older leaves, then yellowing in the middle of the leaf.
- Colours are more intense between leaf veins and on the upper side of the leaf.
- Petioles and leaf veins are green or pale.
- Discoloured leaves become thickened and may cup inwards.
- Infected plants are often stunted and pale, and produce few flowers or seeds.
- Late-infected plants show leaf symptoms but are not stunted and have lower yield loss. [23]

Growers are advised to check canola crops early in the season for aphid presence. If aphids are found, an effective insecticide should be applied.

There is no indication that the occurrence of BWYV in canola poses a threat to neighbouring pulse crops.[24]

**More information**

GRDC Update Papers: *Beet western yellows virus* (synonym: *Turnip yellows virus)* and green peach aphid in canola

Canola diseases. The Back Pocket Guide

GRDC Media Centre: Watch for chickpea viruses near canola

[21] GRDC (2014) Canola disease management in the northern region—details. GRDC Gound Cover, 21 March 2014, http://grdc.com.au/Media-Centre/Hot-Topics/Canola-disease-management-in-the-northern-region/Details

[22] eXtensionAUS. Latest on canola disease—2015 GRDC Update Papers. eXtension, http://www.extensionaus.com.au/2015-grdc-update-canola-papers/

[23] B. Coutts (2015) Diagnosing beet western yellow virus in canola. Department of Agriculture and Food Western Australia, https://www.agric.wa.gov.au/mycrop/diagnosing-beet-western-yellow-virus-canola

[24] eXtensionAUS. Latest on canola disease—2015 GRDC Update Papers. eXtension, http://www.extensionaus.com.au/2015-grdc-update-canola-papers/

## More information

NSW DPI: Virus diseases in canola and mustard

GRDC Resources: Reducing aphid and virus risk

GRDC Update Papers: Virus development in canola crops during 2014 in New South Wales and implications for the oilseed and pulse industry

Of the three virus species recorded in canola in Australia, BWYV is the most common and has potential to cause yield losses in canola. Commercial canola varieties appear resistant to *Turnip mosaic virus* (TuMV). However, some lines of condiment mustard and juncea canola (both *Brassica juncea*) have been severely affected by TuMV in trials in northern New South Wales. The importance of *Cauliflower mosaic virus* (CaMV) in canola and *B. juncea* is not known.

All three viruses are spread by aphids from weeds, which act as hosts. BWYV can come from a range of weed, pasture and crop species. Turnip weed, wild radish and other *Brassica* weeds are important hosts of TuMV. Substantial yield losses from viruses, particularly BWYV, can occur even when there are no obvious symptoms.

Seed treated with an imidacloprid product or Poncho® Plus (imidacloprid + clothiandin) is recommended to protect crops from early infestation with aphids. [25]

[25] P Matthews, D McCaffery, L Jenkins (2015) Winter crop variety sowing guide 2015. NSW DPI Management Guide. NSW Department of Primary Industries, http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0011/272945/winter-crop-variety-sowing-guide-2015.pdf