

SECTION 9

Diseases

 More information

[GRDC Ground Cover: Foliar fungal diseases of pulses and oilseeds](#)

[GRDC Update Papers: Viral diseases in canola and winter pulses](#)

Canola can be infected by a number of pathogens in Australia (Table 1), ranging from root rots to leaf disease and crown to stem infections. As with all diseases, their presence and severity depend on plant susceptibility, presence of the pathogen and favourable climatic conditions. Generally, fungal diseases such as blackleg and Sclerotinia disease are more damaging in higher rainfall regions, but if unseasonably high rainfall occurs in lower rainfall regions, these areas may also experience high levels of disease. Disease control varies for each pathogen, but generally, variety resistance, crop production practices and fungicides are used, either alone or in combination to reduce economic losses. If growers are aware of the disease risks in their area and follow strategic management plans, they should be able to control most canola diseases adequately.

Blackleg, caused by the fungus *Leptosphaeria maculans*, is the most damaging disease of canola (*Brassica napus*) in Australia and most canola-producing countries throughout the world. Sclerotinia stem rot and damping-off are other damaging diseases. Alternaria disease, white leaf spot, downy mildew and viruses may be common in some seasons but they do not normally cause significant crop damage. Clubroot has been identified in New South Wales and Victoria.^{1 2}

Table 1: Common diseases of canola

Plant growth stage	Plant part infected	Possible disease
Seedling	Roots	Damping-off
	Hypocotyl	Blackleg
	Leaves	Blackleg, white leaf spot, downy mildew
Rosette	Roots	Damping-off, blackleg, clubroot
	Crown	Blackleg
	Leaves	Blackleg, white leaf spot, downy mildew, white rust
Flowering	Roots	Blackleg, clubroot
	Crown	Blackleg
	Leaves	Alternaria disease, blackleg, white leaf spot, white rust
Podding	Stem and branches	Alternaria disease, blackleg, sclerotinia?
	Roots	Blackleg, clubroot
	Crown	Blackleg
	Stem and branches	Alternaria disease, blackleg, Sclerotinia disease
	Pods	Alternaria disease, blackleg, white rust

¹ S Marcroft, T Hind-Lanoiselet (2009) Diseases of canola and their management. Ch. 10. In Canola best practice management guide for south-eastern Australia. (Eds D McCaffrey, T Potter, S Marcroft, F Pritchard) GRDC, http://www.grdc.com.au/uploads/documents/GRDC_Canola_Guide_All_1308091.pdf

² S Marcroft, C Bluett (2008) Canola diseases. AG1354. Revised 2010. State Government Victoria, <http://agriculture.vic.gov.au/agriculture/pests-diseases-and-weeds/plant-diseases/grains-pulses-and-cereals/canola-diseases>

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 500 m, and using a fungicide seed dressing or fungicide-amended fertiliser.

Most spores that infect new-season crops originate from the previous year's stubble. Significant numbers of spores from 2-year-old stubble may be produced if seasonal conditions have been dry or if the stubble is still largely intact. Spores can travel 1–2 km on the wind, but most originate more locally. 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, it is the least effective strategy for managing blackleg and is therefore not generally recommended.³



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](#)

9.1.1 Symptoms and disease cycle

Blackleg survives on canola stubble, producing fruiting bodies that contain large quantities of airborne spores (capable of travelling several kilometres). These dark-coloured, raised fruiting bodies (pseudothecia) can easily be seen with the naked eye (see Figure 1). The date of spore release from the stubble depends on autumn rainfall. Higher rainfall results in earlier spore release and may lead to increased disease severity.

In the autumn and winter, rainfall triggers spore release from the stubble. Within 2 weeks of spores landing on canola cotyledons and young leaves, clearly visible, off-white lesions develop. Within the lesion, pycnidial fruiting bodies (dark-coloured dots in Figure 2) release rain-splashed spores. Once a lesion has formed, the fungus grows within the plants vascular system to the crown where it causes the crown of the plant to rot, resulting in a canker. Severe canker will sever the roots from the stem (Figure 3), whereas a less severe infection will result in internal infection of the crown, restricting water and nutrient flow within the plant.

In recent years, blackleg symptoms have also been found in the plant roots (Figure 4); this root infection in severe cases appears to cause the entire plant to die prematurely.

³ 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

The root-rot form of the disease is caused by the same blackleg strains that cause the stem canker, and management practices are the same for both forms of the disease.⁴



Figure 1: Stubble with blackleg fruiting bodies that produce wind-borne spores. (Photo: B. Howlett, University of Melbourne)



Figure 2: Blackleg lesion on leaf; the small black dots are fruiting bodies that produce spores spread by rain-splash. (Photo: S. Marcroft, MGP)



Figure 3: Canola plant falling over from stem canker. (Photo: S. Marcroft, MGP)

⁴ S Marcroft, C Bluett (2008) Blackleg of canola. AG1352. Revised 2013. State Government Victoria, <http://agriculture.vic.gov.au/agriculture/pests-diseases-and-weeds/plant-diseases/grains-pulses-and-cereals/blackleg-of-canola>

i More information

GRDC UPDATE
PAPER: [Blackleg pod infection, resistance group monitoring and sclerotinia](#)



Figure 4: Root-rot form of blackleg (diseased plant on left). (Photo: S. Sprague, CSIRO)

9.1.2 Management

Blackleg can be successfully managed by:

- growing resistant varieties
- avoiding the previous year's stubble
- using fungicides in high-risk situations

Choose a variety with adequate blackleg resistance

The best defence against blackleg is varietal resistance. The blackleg resistance ratings of all Australian canola varieties are published by the Canola Association of Australia in February each year. To find the most up-to-date ratings, go to the [Australian Oilseeds Federation \(AOF\)](#) website. Click on [Commodity Groups](#), then [Canola Association of Australia](#), then [Pests and Diseases](#).

Blackleg rating data are collected each year from a number of sites in New South Wales, Victoria, South Australia and Western Australia. It is important to consult only the current blackleg-rating guide, because blackleg resistance ratings can change from one year to the next due to changes in the frequency of different blackleg strains.

A rating of MS (moderately susceptible) is considered adequate for lower rainfall regions, whereas a minimum of MR (moderately resistant) is required for medium-high-rainfall areas.⁵

Isolate this year's crop from last year's canola stubble

Varietal resistance alone is not enough to protect your crop from yield loss caused by blackleg. It is also crucial to avoid high levels of disease pressure by reducing exposure to large inoculum loads. In most situations, >95% of all blackleg spores in the atmosphere originate from canola stubble from the previous year's crop. Older stubble does not produce many blackleg spores. Therefore, sow crops away from last year's canola stubble. Disease pressure falls markedly in the first 200 m away from last year's stubble and then continues to decline up to 500 m (Figure 5). There appears to be little advantage in increasing the isolation distance past 500 m.

Block farming has been beneficial in managing blackleg, where groups of adjoining paddocks are sown to canola in the same year.

Agronomist's view

⁵ S Marcroft, C Bluett (2008) Blackleg of canola. AG1352. Revised 2013. State Government Victoria, <http://agriculture.vic.gov.au/agriculture/pests-diseases-and-weeds/plant-diseases/grains-pulses-and-cereals/blackleg-of-canola>

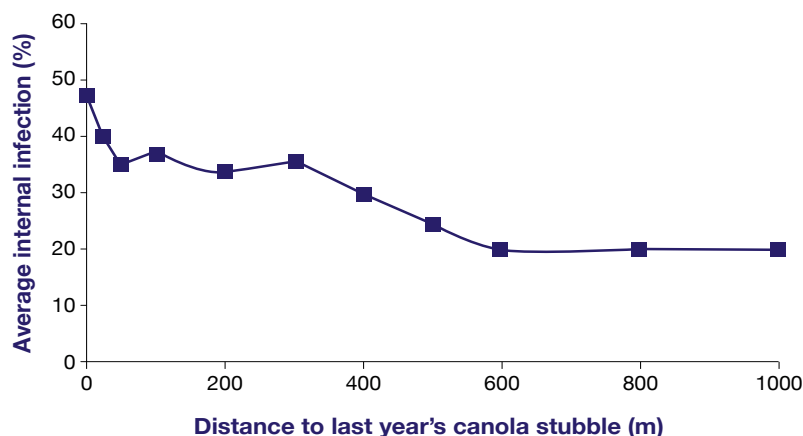


Figure 5: Average internal infection as affected by distance to last year's stubble.

Stubble management such as raking and burning or burial can reduce disease pressure by up to 50%. However, it is not known how much stubble must be destroyed to achieve an economic benefit through decreased blackleg severity. Extending the time between canola crops within a paddock's rotation sequence does not reduce disease severity because of the wind-borne nature of the spores. Paddocks that have been sown into 3-year-old stubble do not have less disease than crops sown in paddocks with a 2-year break from canola.⁶

Consider fungicide use

Fungicides applied as a seed dressing (e.g. Jockey®; active ingredient (a.i.) fluquinconazole) or on the fertiliser (e.g. Titan Flutriafol 250 SC Fungicide, Innova® Flutriafol 250, Intake® Combi; a.i. flutriafol) reduce the severity of blackleg. Both fungicides give initial protection to canola seedlings, when the plant is most vulnerable to attack from blackleg. However, fungicides may not always give an economic return.

Generally, if varieties with low blackleg resistance ratings are sown in higher rainfall areas or if varieties with good resistance are sown into situations of high disease pressure, then fungicides are more likely to provide an economic benefit. The economic viability of using fungicides in other situations should be determined by monitoring the number of cankered plants in the current season's crop. If >3% of plants are cankered, the use of a fungicide may be warranted in future seasons.⁷

All current canola varieties are 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 2015 Fact Sheet](#) to determine the resistance group for your current canola varieties and select future varieties that belong to a different group.⁸

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.

⁶ S Marcroft, C Bluett (2008) Blackleg of canola. AG1352. Revised 2013. State Government Victoria, <http://agriculture.vic.gov.au/agriculture/pests-diseases-and-weeds/plant-diseases/grains-pulses-and-cereals/blackleg-of-canola>

⁷ S Marcroft, C Bluett (2008) Blackleg of canola. AG1352. Revised 2013. State Government Victoria, <http://agriculture.vic.gov.au/agriculture/pests-diseases-and-weeds/plant-diseases/grains-pulses-and-cereals/blackleg-of-canola>

⁸ 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

[Prosaro fungicide in canola](#)

[Assess blackleg risk to canola yields before spraying crops](#)

[Prosaro® 420 SC Fungicide 2013 Product Guide](#)

More information

[GRDC: Blackleg management guide 2015 Fact Sheet](#)

[GRDC Media: GRDC funding canola stubble screening for fungicide tolerant blackleg](#)

[GRDC: Blackleg management guide 2014 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](#)

9.1.3 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

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 6 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 (see Figure 6). 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.

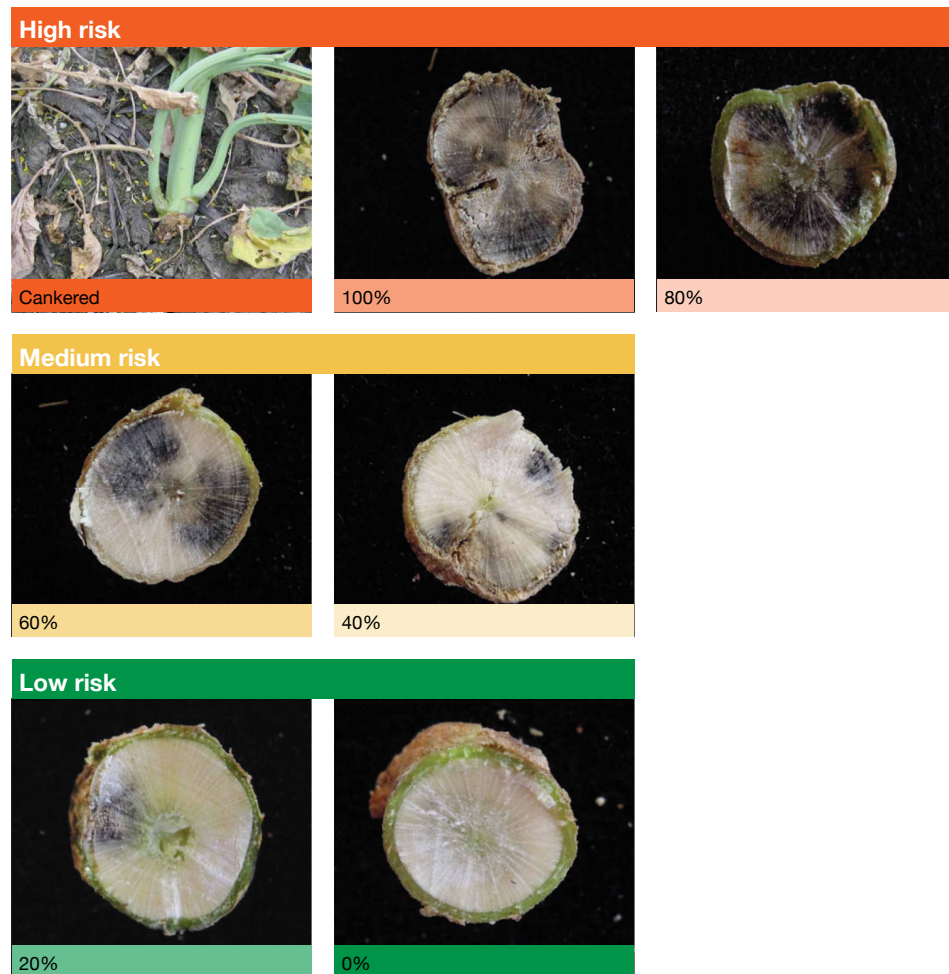


Figure 6: Crop blackleg severity.

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 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 2015 Fact Sheet](#)). You do not need to change resistance groups (cultivars) every year.⁹

9.1.4 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.

⁹ GRDC (2015) Blackleg management guide, spring 2015. GRDC Fact Sheet, 23 September 2015, <http://www.grdc.com.au/GRDC-FS-BlacklegManagementGuide>

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 causing 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 2015 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 populations of blackleg pathogens 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 Western Australia, New South Wales, South Australia and Victoria.¹⁰

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

More information

[eXtensionAUS: Blackleg monitoring sites](#)

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.¹¹ The blackleg-resistance ratings for all varieties for 2015 are available in the [Blackleg management guide 2015 Fact Sheet](#) (see table 3 therein).¹²

9.2 Sclerotinia stem rot

Sclerotinia stem rot, caused by the fungus *Sclerotinia sclerotiorum*, is a fungal disease that can infect a wide range of broadleaf plants, including canola, peas, beans, sunflowers, pasture species, weeds and lupins. The disease is sporadic, occurring when environmental conditions are favourable for infection. Disease development is favoured by prolonged wet conditions in late winter followed by periods of prolonged leaf wetness during flowering.

¹⁰ GRDC. Advances in blackleg management. 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>

¹¹ 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

¹² GRDC (2015) Blackleg management guide, spring 2015. GRDC Fact Sheet, 23 September 2015, <http://www.grdc.com.au/GRDC-FS-BlacklegManagementGuide>

Yield losses generally 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 soilborne 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® (a.i.s 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](#).^{13 14}

9.2.1 Symptoms

The disease infects canola crops from late flowering onwards, with symptoms appearing 2–3 weeks after infection. The fungus produces light brown, discoloured patches on stems, branches and pods. These lesions expand and take on a greyish-white colour. Infected canola plants ripen earlier and stand out as bleached or greyish-coloured plants among green healthy plants. The bleached stems tend to break and shred at the base. When an infected canola stem is split open, hard black bodies (sclerotia) can usually be found inside. Sclerotia are the resting stage of the fungus and resemble rat droppings; they may be round like canola seed, or rod, cylinder or irregular shaped, 2–4 mm in diameter and up to 20 mm long. In wet or humid weather, a white growth resembling cotton wool can develop on lesions and sclerotia may also develop in this white growth.

9.2.2 Disease cycle

Sclerotia remain viable for many years in the soil. When weather conditions are favourable, the sclerotia germinate to produce small, mushroom-shaped structures called apothecia (Figure 7). Apothecia produce thousands of air-borne spores that can be carried several kilometres by the wind. Spores land on canola petals, germinate, and then use the petal as a nutrient source, producing a fungal mycelium. When the petals fall at the end of flowering, they are often caught in the lower canopy of the crop, allowing the fungus to grow from the petal into the plant. The canola flowering period is therefore the critical time for *Sclerotinia* infection. Germination of the spores and infection is enhanced by wet weather at flowering.¹⁵

¹³ 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

¹⁴ GRDC (2014) *Sclerotinia* stem rot in canola. GRDC Fact Sheet, 3 March 2014, <http://www.grdc.com.au/Resources/Factsheets/2014/03/Sclerotinia-Stem-Rot-in-Canola>

¹⁵ S Marcroft, C Bluett (2008) Canola diseases. AG1354. Revised 2010. State Government Victoria, <http://agriculture.vic.gov.au/agriculture/pests-diseases-and-weeds/plant-diseases/grains-pulses-and-cereals/canola-diseases>

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 Centre: Tips and tools for managing Sclerotinia in 2015](#)

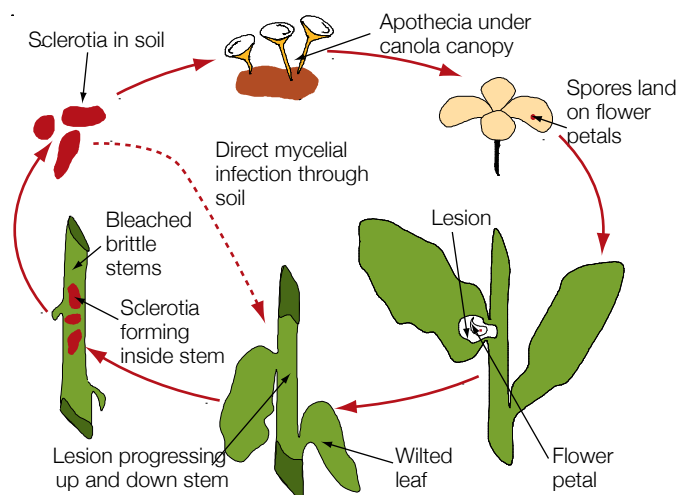


Figure 7: Disease cycle of *Sclerotinia stem rot*.

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.
- 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.¹⁶

9.3 Clubroot in canola and *B. juncea*

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 Western Australia.

In Australian vegetable brassicas, clubroot is widespread and causes significant yield losses. However, the Australian oilseed industry has been somewhat protected from clubroot because the major production areas for vegetable and oilseed brassicas are usually separated from each another. In addition, most Australian pathotypes of clubroot are able to cause disease only in the warmer months and require irrigation water for dispersal, except in Tasmania and some parts of New South Wales where disease is observed year-round.¹⁷

9.3.1 Symptoms

Swollen, galled roots are the most typical symptom of infected plants (Figure 8). This ranges from tiny nodules to large, club-shaped outgrowths. The galls are at first firm and white but become soft and greyish brown as they mature and decay. Affected roots have an impaired ability to transport water and nutrients.¹⁸

¹⁶ GRDC (2014) Canola disease management in the northern region. GRDC Media Centre, 21 March 2014, <http://grdc.com.au/Media-Centre/Hot-Topics/Canola-disease-management-in-the-northern-region>

¹⁷ S Marcroft, C Bluett (2008) Canola diseases. AG1354. Revised 2010. State Government Victoria, <http://agriculture.vic.gov.au/agriculture/pests-diseases-and-weeds/plant-diseases/grains-pulses-and-cereals/canola-diseases>

¹⁸ S Marcroft, C Bluett (2008) Canola diseases. AG1354. Revised 2010. State Government Victoria, <http://agriculture.vic.gov.au/agriculture/pests-diseases-and-weeds/plant-diseases/grains-pulses-and-cereals/canola-diseases>



Figure 8: Canola roots with severe clubroot.

9.3.2 Disease cycle

Resting spores of the fungus can survive in soil for many years, even in the absence of a susceptible host. Infection can occur at any stage of growth and is restricted to the roots. In the presence of susceptible roots, the spores germinate and release tiny motile spores, which swim in free water to the surface of the rootlets, penetrate and form a fungal colony (plasmodium) inside the root cells. The fungus causes cells to enlarge and divide rapidly, resulting in the characteristic galls. Late in the season, resting spores develop in the infected roots and they are released into the soil as the galls decay. Fields become infested mainly by the movement of soil on cultivation equipment and by seedling transplants.¹⁹

9.3.3 Management

- In the Australian vegetable brassica industry, several methods of control have been developed that may be useful for oilseed brassicas.
- Use a 5-year rotation. Infested fields are kept free of susceptible crops and weeds for at least 5 years, to allow sufficient natural decay of the long-lived spores.
- Do not move cultivating equipment from infested to non-infested areas before thoroughly cleaning the equipment.
- Clubroot thrives in acid soils (pH <7.0), and liming to increase soil pH (7.0–7.5) has been successful for vegetable brassicas. However, this would be cost-prohibitive in most areas growing oilseed brassicas.²⁰

9.4 *Rhizoctonia*, damping-off

Damping-off is usually caused by the fungus *Rhizoctonia solani*. Other fungi including *Fusarium spp.*, *Pythium spp.*, *Phytophthora spp.*, *Alternaria spp.* and the blackleg fungus, *Leptosphaeria maculans*, can also cause damping-off. Symptoms and crop management are similar for all of these pathogens, so they are grouped together here in reference to damping-off.

All species are common inhabitants of the soil and cause damage when conditions are not ideal for early seedling growth. Problems are usually seen when seed is sown dry, close to the autumn break (within a couple of weeks of a normal break), or if weather conditions become cool and damp. Yield loss is unusual unless plant numbers are severely reduced or patchy establishment occurs.²¹

¹⁹ S Marcroft, C Bluett (2008) Canola diseases. AG1354. Revised 2010. State Government Victoria, <http://agriculture.vic.gov.au/agriculture/pests-diseases-and-weeds/plant-diseases/grains-pulses-and-cereals/canola-diseases>

²⁰ S Marcroft, C Bluett (2008) Canola diseases. AG1354. Revised 2010. State Government Victoria, <http://agriculture.vic.gov.au/agriculture/pests-diseases-and-weeds/plant-diseases/grains-pulses-and-cereals/canola-diseases>

²¹ S Marcroft, C Bluett (2008) Canola diseases. AG1354. Revised 2010. State Government Victoria, <http://agriculture.vic.gov.au/agriculture/pests-diseases-and-weeds/plant-diseases/grains-pulses-and-cereals/canola-diseases>

Seed fungicide treatments such as Maxim XL® (a.i.s fludioxonil + mefenoxam) or Apron XL® (mefenoxam) at sowing can also reduce damage caused by *Rhizoctonia* and/or *Pythium*. See your agronomist and/or www.apvma.gov.au.

9.4.1 Symptoms

Damping-off symptoms range from pre-emergence rot (failure of plants to emerge) to post-emergence damping-off (plants emerge and collapse at ground level). If affected plants survive, they are normally stunted and may flower and mature prematurely. Once past the seedling stage, canola plants are not adversely affected by damping-off. Damping-off, both pre- and post-emergent, occurs in patches, and affected areas can spread quickly during cold, wet conditions. Leaves of plants affected by post-emergent damping-off may become discoloured, turning orange, purple and/or chlorotic. In some cases, the taproot is dark in colour and shrivelled at ground level. These symptoms should not be confused with insect damage where root or stem tissue has been removed.²²

9.4.2 Disease cycle

Damping-off fungi are soilborne and survive in the soil by forming resistant resting structures when no host is present. These resting structures germinate with the break of the season and the fungi grow through the soil until they find a susceptible host plant. Dry seeds become vulnerable to attack as soon as they begin to germinate. Once in the plant, the fungi multiply, causing decay that damages or kills the seedling. Damping-off fungi are usually weak pathogens (except blackleg), able to infect only young, succulent tissue. At the 2–4-leaf stage, belowground parts of canola plants become woody enough to withstand further infections. Therefore, most damage occurs when wet and cold weather slows plant growth. Temperature and soil moisture affect disease development. Loose, cold and dry soils favour *Rhizoctonia solani*, whereas cold damp soils favour *Fusarium spp.* and wet, heavy soils favour *Pythium spp.*²³

9.4.3 Management

- Yields are affected only when plant numbers are severely reduced. If seedling loss is uniform throughout the crop, surrounding plants can often compensate by growing larger. If seedling loss is patchy and large areas die, re-sowing may be required.
- Damping-off fungi will germinate with the opening rains of the season. Once germinated, they are very successfully controlled by soil tillage. Therefore, dry-sown crops or crops sown very close to the opening rains may be more severely affected. If crops are re-sown, the sowing tillage will generally control the fungi.
- Application of a seed fungicide treatment (e.g. Maxim XL®) at sowing can reduce damping-off damage.²⁴

9.5 Downy mildew, powdery mildew

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

Downy mildew is a common disease of canola throughout the world, and is caused by the fungus *Peronospora parasitica*. Infection occurs under cool moist conditions where leaves or cotyledons are in contact with the soil or other leaves. Although seedlings can be severely attacked by the disease, significant yield loss does not usually occur.

²² S Marcroft, C Bluett (2008) Canola diseases. AG1354. Revised 2010. State Government Victoria, <http://agriculture.vic.gov.au/agriculture/pests-diseases-and-weeds/plant-diseases/grains-pulses-and-cereals/canola-diseases>

²³ S Marcroft, C Bluett (2008) Canola diseases. AG1354. Revised 2010. State Government Victoria, <http://agriculture.vic.gov.au/agriculture/pests-diseases-and-weeds/plant-diseases/grains-pulses-and-cereals/canola-diseases>

²⁴ S Marcroft, C Bluett (2008) Canola diseases. AG1354. Revised 2010. State Government Victoria, <http://agriculture.vic.gov.au/agriculture/pests-diseases-and-weeds/plant-diseases/grains-pulses-and-cereals/canola-diseases>

Downy mildew is rarely found beyond the rosette stage and crops normally grow away from it with the onset of warmer weather.²⁵

9.5.1 Symptoms

Chlorotic or yellow areas on the upper leaf surface are the first symptoms to occur. These can be seen on young seedlings when cotyledons or first true leaves are present. With moist conditions or long dew periods, a white, mealy fungal growth can be seen on the underside of the leaf beneath these spots. Infected cotyledons tend to die prematurely. As the disease develops, individual spots join to form large, irregular-shaped blotches. These necrotic lesions may cause a large part of the leaf to dry out and the upper surface of the leaf to develop a yellow–red colour.²⁶

9.5.2 Disease cycle

The fungus is both soil- and seed-borne and can persist in the soil for a long time. Infection is favoured by cool, wet weather, and under ideal conditions, new infections can develop in as little as 3–4 days. The fungus is related to white rust, with specialised spores (oospores) probably responsible for primary infections. Conidial spores produced on the underside of the infected leaf are then responsible for the secondary spread of the disease.²⁷

9.5.3 Management

- Downy mildew does not usually affect yield; therefore, control measures are not generally warranted unless plant densities are severely reduced on a regular basis.
- Where downy mildew is a severe problem, fungicides containing copper as the active ingredient are registered for use in Australia.
- Crop rotation and the control of cruciferous weeds between canola crops can reduce disease severity.²⁸

9.6 White leaf spot

White leaf spot is caused by the fungus *Mycosphaerella capsellae* (also called *Pseudocercospora capsellae*). The disease has a worldwide distribution and a wide host range among cruciferous weeds. In Australia, white leaf spot commonly infects canola seedlings. Usually, it is not severe enough to cause yield loss.²⁹

White leaf spot is more common in wetter years. The disease is generally present on leaves of young canola plants (Figure 9); 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.

²⁵ S Marcroft, C Bluett (2008) Canola diseases. AG1354. Revised 2010. State Government Victoria, <http://agriculture.vic.gov.au/agriculture/pests-diseases-and-weeds/plant-diseases/grains-pulses-and-cereals/canola-diseases>

²⁶ S Marcroft, C Bluett (2008) Canola diseases. AG1354. Revised 2010. State Government Victoria, <http://agriculture.vic.gov.au/agriculture/pests-diseases-and-weeds/plant-diseases/grains-pulses-and-cereals/canola-diseases>

²⁷ S Marcroft, C Bluett (2008) Canola diseases. AG1354. Revised 2010. State Government Victoria, <http://agriculture.vic.gov.au/agriculture/pests-diseases-and-weeds/plant-diseases/grains-pulses-and-cereals/canola-diseases>

²⁸ S Marcroft, C Bluett (2008) Canola diseases. AG1354. Revised 2010. State Government Victoria, <http://agriculture.vic.gov.au/agriculture/pests-diseases-and-weeds/plant-diseases/grains-pulses-and-cereals/canola-diseases>

²⁹ S Marcroft, C Bluett (2008) Canola diseases. AG1354. Revised 2010. State Government Victoria, <http://agriculture.vic.gov.au/agriculture/pests-diseases-and-weeds/plant-diseases/grains-pulses-and-cereals/canola-diseases>



Figure 9: White leaf spot on a leaf.

9.6.1 Symptoms

Leaf, stem and pod lesions are greyish-white to light brown. Unlike blackleg lesions, white leaf spot lesions do not contain pycnidial fruiting bodies (black dots) and usually have a more granular surface, compared with the smooth surface of blackleg lesions. Leaf lesions often have a brown margin when they mature; they can be up to 1 cm in diameter and often join to form large, irregular-shaped lesions. Nutrient-deficient crops have been reported as more severely affected by the disease. In severe epidemics, infections can defoliate susceptible varieties.³⁰

9.6.2 Disease cycle

The fungus survives on canola stubble as thick-walled mycelium. When prolonged wet-weather conditions prevail during autumn–winter, wind-borne spores are produced that cause primary leaf lesions on canola. These initial lesions go on to produce new wind-borne spores that cause the rapid spread of disease throughout the crop. The disease is not usually seed-borne but can be spread by infected seeds or infected debris with the seed.³¹

9.6.3 Management

- White leaf spot infection is not usually severe enough to warrant control.
- Crop rotation and isolation from the previous year's canola stubble will prevent infection from wind-borne spores.
- Control cruciferous weeds and volunteer canola.
- Provide adequate nutrition to reduce crop stress.³²

9.7 White rust or staghead

White rust is caused by the fungus *Albugo candida*. The disease is uncommon on *B. napus* (Australian canola varieties) but does infect *B. juncea* (juncea canola or Indian mustard) and the weed shepherds purse (*Capsella bursa-pastoris*).³³

³⁰ S Marcroft, C Bluett (2008) Canola diseases. AG1354. Revised 2010. State Government Victoria, <http://agriculture.vic.gov.au/agriculture/pests-diseases-and-weeds/plant-diseases/grains-pulses-and-cereals/canola-diseases>

³¹ S Marcroft, C Bluett (2008) Canola diseases. AG1354. Revised 2010. State Government Victoria, <http://agriculture.vic.gov.au/agriculture/pests-diseases-and-weeds/plant-diseases/grains-pulses-and-cereals/canola-diseases>

³² S Marcroft, C Bluett (2008) Canola diseases. AG1354. Revised 2010. State Government Victoria, <http://agriculture.vic.gov.au/agriculture/pests-diseases-and-weeds/plant-diseases/grains-pulses-and-cereals/canola-diseases>

³³ S Marcroft, C Bluett (2008) Canola diseases. AG1354. Revised 2010. State Government Victoria, <http://agriculture.vic.gov.au/agriculture/pests-diseases-and-weeds/plant-diseases/grains-pulses-and-cereals/canola-diseases>

9.7.1 Symptoms

White-cream-coloured pustules form on the underside of leaves and on floral parts. These pustules rupture the host epidermis, exposing a white chalky dust. On the upper surface of the leaves, the infected areas are bleached and thickened. Systemic infections of the growing tips and flower heads give rise to stagheads, which are very conspicuous in the crop as swollen, twisted and distorted flower heads that produce little to no seed and become brown and hard as they mature. Symptoms for white rust should not be confused with symptoms of severe calcium deficiency, which cause flowering stalks to collapse, resulting in the withering death of the flower head.³⁴

9.7.2 Disease cycle

Resting spores (oospores) of the fungus can survive in infected plant material or as a seed contaminant for many years when conditions remain dry. When conditions become moist, the resting spores are able to infect plants directly. However, they usually produce tiny motile spores, which can swim in free water to infect seedlings, causing cream-white pustules to form. Inside the pustules, new swimming spores are formed and then distributed throughout the canopy by rain splash to form secondary infections. They do this by growing through stomata into adjacent cells, causing systemic infections and then stagheads if the growing tips of plants become infected. The resting spores can be formed in any infected tissues but are present in larger numbers in stagheads. When the crop is harvested, stagheads break, releasing resting spores that contaminate harvested seed or blow out to contaminate the soil.³⁵

9.7.3 Management

- Obtain seed from disease-free or low-disease crops.
- Control cruciferous weeds.
- Extended rotations will allow crop residues to decompose and reduce the risk of infections.
- If appropriate, consider growing *B. napus* rather than *B. juncea*.³⁶

9.8 Alternaria leaf and pod spot

Alternaria disease is usually caused by the fungal pathogen *Alternaria brassicae*, and occasionally by *Alternaria brassicicola*. Canola cultivars are more resistant to *A. brassicicola*. The severity of the disease varies between years and locations depending on seasonal conditions. The disease is favoured by warm, humid conditions during spring. Yield loss is unusual and is normally associated with the shattering of infected pods. If infected seed is sown, seedling blight may occur (refer to above discussion of damping-off).³⁷

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* spp. in canola.

³⁴ S Marcroft, C Bluett (2008) Canola diseases. AG1354. Revised 2010. State Government Victoria, <http://agriculture.vic.gov.au/agriculture/pests-diseases-and-weeds/plant-diseases/grains-pulses-and-cereals/canola-diseases>

³⁵ S Marcroft, C Bluett (2008) Canola diseases. AG1354. Revised 2010. State Government Victoria, <http://agriculture.vic.gov.au/agriculture/pests-diseases-and-weeds/plant-diseases/grains-pulses-and-cereals/canola-diseases>

³⁶ S Marcroft, C Bluett (2008) Canola diseases. AG1354. Revised 2010. State Government Victoria, <http://agriculture.vic.gov.au/agriculture/pests-diseases-and-weeds/plant-diseases/grains-pulses-and-cereals/canola-diseases>

³⁷ S Marcroft, C Bluett (2008) Canola diseases. AG1354. Revised 2010. State Government Victoria, <http://agriculture.vic.gov.au/agriculture/pests-diseases-and-weeds/plant-diseases/grains-pulses-and-cereals/canola-diseases>

9.8.1 Symptoms

Alternaria infects all growth stages of canola plants. However, as plants mature from mid-flowering onwards, they are more susceptible to infection. Symptoms can be found on all parts of the plant including leaves, stems and pods. Spots on leaves and pods have a concentric or target-like appearance and are brown, black or greyish white with a dark border. Lesions on green leaves are often surrounded by a chlorotic (yellow) halo. Severe pod infections may cause seed to shrivel and the pods to ripen prematurely and shatter. Stem spots are elongated and almost black. Pod symptoms of *Alternaria* disease are similar to those of blackleg and the two can be difficult to distinguish in the field.³⁸

9.8.2 Disease cycle

Alternaria spp. survive the intercropping period on infected canola stubble, on cruciferous weeds and, to a lesser extent, on seed. Seed infections can cause seedlings to rot, resulting in a seedling blight that reduces plant establishment. Initial crop infections are caused by wind-blown spores. Spores remain intact on susceptible plants until moisture from dew or rain allows them to penetrate into the tissue and cause a lesion. These lesions produce further spores, and infections can then be spread throughout the crop by either wind or rain. Mild, humid conditions favour disease development, and the disease cycle will continue throughout the season under favourable conditions. Hot and dry conditions interrupt epidemics, the absence of moisture greatly reducing spore production. Major outbreaks are not common in Australia because weather conditions are normally hot and dry throughout podding, and this is unfavourable for prolonged infection.³⁹

9.8.3 Management

- *Alternaria* disease is very common in canola crops but is not usually severe enough to warrant control.
- In Australia, there are no registered fungicide seed treatments for this pathogen.
- If pods were infected in the previous season, obtain fresh, disease-free seed.
- In areas where *Alternaria* disease is a problem, select paddocks isolated from last year's canola stubble because spores are easily transported by wind and they can spread into areas that have not grown canola for several years.⁴⁰

9.9 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.⁴¹

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*).

³⁸ S Marcroft, C Bluett (2008) Canola diseases. AG1354. Revised 2010. State Government Victoria, <http://agriculture.vic.gov.au/agriculture/pests-diseases-and-weeds/plant-diseases/grains-pulses-and-cereals/canola-diseases>

³⁹ S Marcroft, C Bluett (2008) Canola diseases. AG1354. Revised 2010. State Government Victoria, <http://agriculture.vic.gov.au/agriculture/pests-diseases-and-weeds/plant-diseases/grains-pulses-and-cereals/canola-diseases>

⁴⁰ S Marcroft, C Bluett (2008) Canola diseases. AG1354. Revised 2010. State Government Victoria, <http://agriculture.vic.gov.au/agriculture/pests-diseases-and-weeds/plant-diseases/grains-pulses-and-cereals/canola-diseases>

⁴¹ GRDC (2014) Canola disease management in the northern region—details. GRDC Ground Cover, 21 March 2014, <http://grdc.com.au/Media-Centre/Hot-Topics/Canola-disease-management-in-the-northern-region/Details>

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 into standing wheat stubble.⁴²

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.⁴³

Growers are advised to check canola crops early in the season for presence of aphids. 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.⁴⁴

Of the three virus species recorded in canola in Australia, BWYV is the most common and has potential to cause yield losses. Commercial canola varieties appear resistant to *Turnip mosaic virus* (TuMV). However, some lines of condiment mustard and juncea canola (both *B. 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 + clothianidin) is recommended to protect crops from early infestation with aphids.⁴⁵

9.9.1 Disease cycle

These viruses are not seed-borne. They survive in weeds or volunteer host plants during summer and they are then spread from these plants into crops by aphids, which act as the vector for transmission. BWYV is termed a persistent virus. Persistent viruses are carried in the aphid's body and can be transmitted to healthy plants during feeding. Aphids will often remain infective throughout their life. CaMV and TuMV are non-persistent viruses, being retained in the aphid mouthparts for <4 h.⁴⁶

⁴² eXtensionAUS. Latest on canola disease—2015 GRDC Update Papers. eXtension, <http://www.extensionaus.com.au/2015-grdc-update-canola-papers/>

⁴³ 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>

⁴⁴ eXtensionAUS. Latest on canola disease—2015 GRDC Update Papers. eXtension, <http://www.extensionaus.com.au/2015-grdc-update-canola-papers/>

⁴⁵ 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

⁴⁶ S Marcroft, C Bluett (2008) Canola diseases. AG1354. Revised 2010. State Government Victoria, <http://agriculture.vic.gov.au/agriculture/pests-diseases-and-weeds/plant-diseases/grains-pulses-and-cereals/canola-diseases>

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](#)

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](#)

Autumn is the critical infection period, so the earliest sown crops usually have the highest infection incidence. Yield loss is greater in crops that have been infected as seedlings. Infections can occur past the rosette stage of canola growth but these probably have little effect on yield.⁴⁷

9.9.2 Management

- Control broadleaf weeds (especially over summer), which can act as reservoirs for the viruses.
- Sow at recommended times; earlier sown crops usually have a greater incidence of viral infection.
- Monitor aphid numbers in crops (aphids are usually found under leaves) and consider using an insecticide as a foliar (a.i. pirimicarb) or seed treatment (a.i. imidacloprid) to control aphids on seedlings and young canola plants.⁴⁸

There has been resistance to pirimicarb in green peach aphid so growers would need to use Transform or another new generation insecticide when targeting GPA. This is less of an issue if other aphids like cabbage and turnip are the main pest.

Agronomist's view

⁴⁷ S Marcroft, C Bluett (2008) Canola diseases. AG1354. Revised 2010. State Government Victoria, <http://agriculture.vic.gov.au/agriculture/pests-diseases-and-weeds/plant-diseases/grains-pulses-and-cereals/canola-diseases>

⁴⁸ S Marcroft, C Bluett (2008) Canola diseases. AG1354. Revised 2010. State Government Victoria, <http://agriculture.vic.gov.au/agriculture/pests-diseases-and-weeds/plant-diseases/grains-pulses-and-cereals/canola-diseases>