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Sclerotinia stem rot and its management in canola

Department of Primary Industries and Regional Development, Western Australia

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Sclerotinia stem rot, caused by the fungus *Sclerotinia sclerotiorum, is a disease* of canola that can cause significant yield losses exceeding 20% under conducive conditions. This disease occurs in all areas of the WA grainbelt.

Sclerotinia stem rot is one of the most variable and unpredictable diseases of canola, with incidence of infection varying greatly between paddocks and between years. Yield losses can be severe in years of higher moisture, cool conditions, and high humidity, which favour disease development.

This factsheet details the symptoms, disease risk and spread, yield and quality losses, and integrated disease management tactics for sclerotinia stem rot in canola.

Image 1: Early stem lesions appear as a bleached oval area on infected stems. Photo – Ciara Beard, Department of Primary Industries and Regional Development

Symptoms

Plant

- Sclerotinia can infect any part of the plant. Visible symptoms are commonly found on the stem and branches, and sometimes leaves and pods.
- Light brown watery discoloured fungal patches on stems, branches and pods that expand and take on a grey-white colour.
- Sometimes covers portions of the canola stem just above soil level but can occur at any height in the canopy.
- Lesions girdle the stem causing parts above the lesion to die.
- Hard black bodies called sclerotia are found inside an infected stem when it is split open. In moist weather, sclerotia can also form on the outside of the infected stem or roots.
- After infection is well established, plants wilt and die prematurely, resulting in lodging and reduced seed production.
- Advanced infection will have sclerotia (hard, black, generally irregular-shaped to rounded bodies) growing on the inside of the affected and bleached parts of the stem.
- The sclerotia, which are larger than 2 millimetres (mm) in diameter, are the survival structure of the fungus. They appear like rat droppings. Bleached stems can be carefully split to observe the black sclerotia within.
- In wet or humid weather, canola pods also may become infected. Infected pods appear cream-white in colour resembling cotton wool and usually contain white mouldy seeds. In some instances, these seeds are replaced by sclerotia, which contaminate harvested seed samples.

Image 2: Sclerotinia infection causes cream-white coloured pods that usually contain mouldy seeds

Image 3: Breaking open the bleached canola stem may reveal black sclerotes, the resting phase of the fungus. Photo – Ciara Beard, Department of Primary Industries and Regional Development

Paddock

- Bleached or light brown dead plants among green healthy plants after flowering.

Image 4: An infected canola stem stands out in the paddock as looking bleached and maturing early amidst healthy plants. Photo – Ciara Beard, Department of Primary Industries and Regional Development

Background

- Sclerotinia can survive as sclerotia (hard, dark resting bodies) in the soil for up to 6 years and infect plants such as broadleaf crops and broadleaf weeds, such as wild radish and capeweed, which play a role in carryover of the fungus.
- Lupins, lentils, vetch and chickpeas are commonly infected whereas faba beans and field peas are less susceptible.
- During cool moist weather, sclerotia near the surface germinate and produce small, cream, mushroom-like bodies called apothecia. These containing many spores that are carried by the wind to nearby crops.
- Normally, the spore must first germinate on, then infect, dead or dying plant material (such as flower petals) before it invades healthy tissues.
- Infected petals that lodge between in leaf axils are a major infection source.
- In wet years, basal stem infection can occur prior to flowering. This is caused when sclerotia in the soil germinate to produce mycelium that can directly penetrate canola leaves that touch the ground or the stem base of a nearby canola plant. Basal stem infection appears as fluffy white growth on the soil, leaves, and stem base where it touches the soil.
- Less commonly, sclerotia directly infect the stem at the surface, causing a collar rot that kills the plant.

Factors favouring disease risk and spread

Risk factors for sclerotinia stem rot infection include:

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

Cool, wet weather favours the disease and mists, dews and fogs provide enough moisture for infection.

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

Sclerotinia spores can blow in on the wind from neighbouring paddocks that previously had the disease.

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

- sclerotinia has been present within the past 6 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 broadleaf crop has been grown in the past 2 years, 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 on the primary stem in a crop is the weather during and after flowering.

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 or more.

Infrequent rain or light showers are unlikely to result in sufficient canopy wetness for yield-limiting infections to occur. However, humid conditions under the canopy of high biomass crops increase the risk of light showers causing sclerotinia stem rot.

Sclerotinia disease levels are closely related therefore to seasonal rainfall and the disease is mostly a problem in average to above average rainfall seasons.

Under extremely moist conditions, sclerotia resting in the soil can also germinate to produce hyphae or mycelium that can penetrate the stem base of a nearby canola plant and cause basal stem infection.

Direct germination of sclerotia is not a common cause of infection in canola but has been observed in WA in wet years, such as 2016 and 2018.

Image 5: In wet years, sclerotinia mycelium may be observed on leaves on the ground and the base of the stem prior to flowering. This is known as basal infection. Photo – Ciara Beard, Department of Primary Industries and Regional Development

Biology and lifecycle

Sclerotinia survives as sclerotia in the soil for up to 6 years. The fungus may also survive by colonising other host broadleaf plants such as lupins, chickpeas, lentils, vetch, faba beans, and field peas, and weeds such as wild radish and capeweed.

During cool (10 to 22ºC), moist weather in autumn or winter, sclerotia in the soil (fruiting bodies that look like rat droppings) germinate and produce small, cream/brown/orange, mushroom-like bodies called apothecia. These grow to be about 5 mm in diameter and become darker coloured as they age.

Sclerotia germination usually occurs when the crop canopy has closed over (for example, from cabbage stage in canola), as this creates a humid, protected environment.

Department research has found that a single sclerote can produce multiple apothecia at a time, and some produce multiple generations over several months if weather conditions are favourable. Most apothecia last at least 2 weeks under optimal conditions and at most 5 weeks, with the average being around 3 weeks.

Image 6: Healthy young apothecia of sclerotinia look like tiny white mushrooms (top) and over time as they age, they dehydrate and turn brown (bottom). Photo – Ciara Beard, Department of Primary Industries and Regional Development

Apothecia produce large numbers (millions) of ascospores, which become airborne and blow to nearby crop plants. While the spores rarely directly infect healthy stems and leaves, they readily infect canola petals (illustrated below) if weather conditions are favourable. When infected petals fall into the canopy and stick to leaf axils, the fungus invades healthy leaves and stems using the infected petal as a food source.

There are 3 trigger points (stages) required for sclerotinia infection to occur in canola and all need specific favourable weather conditions to be successful:

1. Germination of sclerotia to form apothecia (in autumn/winter) that produce ascospores - cool (10 to 22ºC), moist weather.
2. During crop flowering, infection of petals by the ascospores - moist humid weather.
3. Infection of the crop as infected petals fall into the crop canopy - cool moist humid weather (temperatures below 25°C).

If the presence of apothecia does not coincide with crop flowering (for petals to be infected) and/or if weather conditions are not suitable at any of these 3 stages, significant stem infection will not occur.

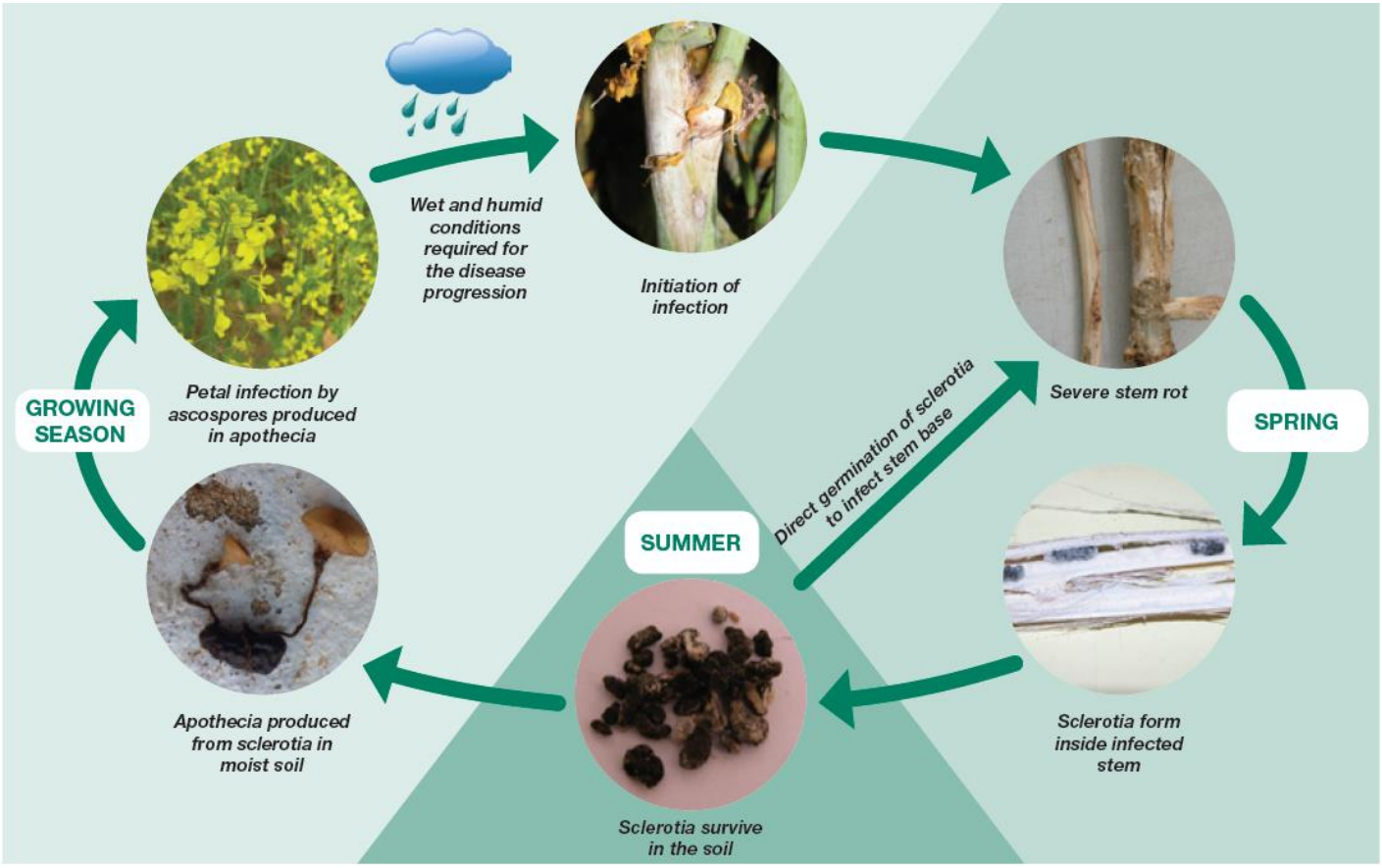

Figure 1: Infected canola stems stand out in the paddock as looking bleached and maturing early amidst healthy plants. Figure – Ravjit Khangura, Department of Primary Industries and Regional Development

Diagnosis

DDLS Plant pathology services can confirm disease diagnosis as a charged service.

Call DDLS Plant pathology services on +61 8 9368 3721 or email DDLS Plant pathology services for information about plant disease and virus testing, sample submission forms, and sampling techniques.

Reporting

PestFacts WA is a free weekly e-newsletter published during the growing season that provides information on broadacre disease and pest reports in the WA grainbelt. Subscribe to PestFacts WA newsletter on the website at dpird.wa.gov.au for details about sclerotinia stem rot in your area.

Please report disease finds of apothecia or infected plants to PestFacts WA for the benefit of other growers and the WA canola industry by using the PestFacts WA Reporter app on the website at dpird.wa.gov.au or email PestFacts WA editor.

Integrated disease management strategy

The best management of sclerotinia stem rot in canola is achieved via an integrated disease management (IDM) strategy, including using crop rotations, rotating with non-host crops, avoiding sowing close to last year's infected crop, using clean seed that does not contain sclerotia, and timely use of foliar fungicide if conducive conditions occur.

Under WA conditions, sclerotia can remain viable in the soil for up to 6 years. Research by the Centre for Crop Disease Management (CCDM) into burning stubble found that it can prevent germination of sclerotia on the soil surface within the windrows, but buried sclerotia, those in standing stems, or outside the windrows remain viable.

Research by the department into grinding up sclerotia to simulate the use of a weed seed destructor found that it could provide some reduction in sclerotia germination but would not be a complete solution. Finely ground sclerotia could still germinate to form apothecia, although fewer apothecia formed, they were smaller in size, and did not persist as long compared to those germinated from whole sclerotia.

Crop rotation

Crop rotation can help in reducing disease severity of blackleg, another significant disease of canola.

Leave canola out of the rotation for as long as possible (at least 3 years). Include non-host crop species, such as cereals, in rotations.

Avoid close rotations with broadleaf crop species such as lupins, chickpeas, vetch, and lentils, which are also susceptible.

Windborne spores may be blown into susceptible crops. Separate canola crops by 100 metres or more from paddocks that had conspicuous levels of sclerotinia stem rot in previous years.

Tillage

Mouldboard ploughing of infected stubble may reduce carryover initially to subsequent crops as deep burial (greater than 15 cm) limits germination of sclerotia and development of apothecia. Most sclerotia germinate if they are close (within 2 to 4 cm) to the soil surface.

Initial results from department research show that burying sclerotia for 5 to 7 years generally leads to their degradation, with only the very thin outer layer surviving.

Fungicides

Registered fungicides

The decision to spray should be based on:

- presence of inoculum (previous sclerotinia infections in paddock or nearby sightings of apothecia)
- favourable weather conditions
- crop growth stage, sprays applied in the early bloom stage are most effective
- frequent showers, and humidity in the crop canopy during and after flowering (which is influenced by crop biomass). This is crucial, firstly to enable petal infection to occur, and secondly, once the petals drop, to allow them to infect crop branches/stems
- yield potential.

There are no registered treatments available for management of basal infection in canola. All fungicides recommended are for management of the stem rot form of the disease.

It can be challenging to decide whether to apply a foliar fungicide for sclerotinia stem rot as the fungicides need to be applied preventatively, generally during the early bloom stage, before symptoms of the disease are seen. In many trials conducted by DPIRD, sclerotinia did not eventuate and, when it did, a fungicide application was effective in reducing disease severity but did not always result in a significant yield response.

The SclerotiniaCM app, available on the website at dpird.wa.gov.au, can assist growers with spray decisions for sclerotinia stem rot. It allows users to enter information specific to their paddock (for example, sclerotinia history), crop (for example, target yield, flowering stage), and expected local weather conditions.

Refer to Registered foliar fungicides for broadacre crops in Western Australia on the website at dpird.wa.gov.au for current registrations for both sclerotinia and blackleg in canola. It is important to read product labels carefully before applying products and use fungicides according to the label. Note harvest withholding periods and rotate chemical groups to avoid the development of fungicide resistance.

Timing of fungicide application

The timing of fungicide application is extremely important for the effective control of sclerotinia stem rot in canola. Timing is heavily dependent on seasonal conditions, so can vary year to year.

Department trial data suggests that in the case of early onset of disease, early applications at 15 to 30% bloom give excellent control of the disease. On average in most seasons, application at 20 to 30% bloom may be a good strategy if only one fungicide spray will be applied. These early sprays will also help reduce the incidence of blackleg upper canopy infection (see the UCI BlacklegCM app) in susceptible varieties.

Single late applications (40 to 50% bloom) may be too late. However, an economic response from late applications may be achieved if the disease epidemic starts late in the season. If an early application was applied (10 to 20% bloom) and the forecast is for a wet spring, which will favour the disease, a second application may be beneficial around 40 to 50% bloom.

Application before 10% flowering (10 flowers open on main stem) is usually not economic and spraying after 50% is not recommended due to harvest withholding period (read product label).

Sclerotinia infection and spread requires moist conditions. If it is dry or hot (>25ºC), disease progression in the crop will slow. Hence, being flexible and monitoring future rainfall patterns is important in the timing of fungicide application, and applying close to the next rainfall event is a good strategy.

The SclerotiniaCM app takes factors such as the disease risk, current price of canola, and yield potential of the crop into account to help users determine the best timing for fungicide application to the crop.

Efficacy and economics of fungicide applications

Department research has shown that in the presence of sclerotinia stem rot disease, treatment with fungicides has reduced the severity of disease by a significant amount, which may result in higher grain yields showing significant improvements compared to untreated controls.

However, the economics of these treatments is largely dependent on the cost of fungicide applied, with more expensive fungicides not improving yields enough to recoup application costs.

Flowering window - varieties and time of sowing

All current commercial canola varieties are considered to have low resistance to sclerotinia. It is difficult to breed canola varieties with resistance to sclerotinia stem rot because of:

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

However, some varieties are less susceptible than others. For variety disease ratings, refer to the current Western Australian crop sowing guide on the website at dpird.wa.gov.au.

Risk of infection each year is related to whether a variety's flowering window coincides with spore release or extended humid weather conditions in that season.

In average years, late flowering/late sown varieties can escape infection. In other years, if autumn is dry and spore release occurs later than usual, early flowering or early sown varieties may escape the brunt of infection.

Sow only good-quality seed that is free of sclerotia.

Assessment of flowering stages in canola

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

Flowering stage should be assessed on the main stem:

- 10% bloom = 10 flowers open on main stem
- 20% bloom = 14 to 16 flowers open on main stem
- 30% bloom = 17 to 20 flowers open on main stem
- 50% bloom = more than 20 flowers open on main stem, with crop at its most intense yellow (full flower)
- 60% bloom = flowering intensity is beginning to decline.

Figure 2: Guide to canola bloom stages

More information

Refer to the department website at dpird.wa.gov.au for more information about the following:

- Diseases and pests of canola
- DDLS Plant pathology services
- PestFacts WA
- Registered foliar fungicides for broadacre crops in Western Australia
- SclerotiniaCM app

Contact us

Ciara Beard, Grains Senior Research Scientist
+61 8 9956 8504 | Email Ciara Beard

Andrea Hills, Grains Senior Research Scientist
+61 8 9983 1144 | Email Andrea Hills

Jean Galloway, Principal Research Scientist
+61 8 9690 2172 | Email Jean Galloway

Kithsiri Jayasena, Grains Senior Research Scientist
+61 8 9892 8477 | Email Kithsiri Jayasena

DDLS Plant pathology services
+61 8 9368 3351 | Email DDLS Plant Pathology

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