



NSW Agriculture

Canola concepts: managing sclerotinia

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CAUSES OF SCLEROTINIA

Sclerotinia stem rot is a disease that attacks many species of broadleaf plants, including canola, peas, beans, sunflowers, soybeans and lupins. The disease is sporadic, occurring when environmental conditions are favourable, and is mainly caused by the fungus *Sclerotinia sclerotiorum*. In canola, prolonged humid or wet conditions during flowering favour disease development. Yield losses as high as 24% have been recorded under Australian conditions.

Sclerotinia disease



SYMPTOMS

Disease symptoms appear in the crop two to three 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 called sclerotia can usually be found inside. Sclerotia are the resting stage of the fungus and resemble rat droppings. In wet or humid weather, a white growth that resembles cotton wool can develop on the infected stems and sclerotia may also develop on the outside of the stem in this white growth.

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. Apothecia produce thousands of air-borne spores that can be carried several kilometres by the wind. Spores land on canola petals and when the petals fall at the end of flowering, they lodge in the lower canopy of the crop. The spores germinate, and using the petal as a source of nutrient, the fungal mycelium grows and infects the canola plant. The canola flowering period is therefore the critical time for *Sclerotinia* infection. Germination of the spores and infection are enhanced by wet weather at flowering.

BASAL INFECTIONS OF SCLEROTINIA

Sclerotinia is also capable of infecting plants directly from the soil but this type of infection

rarely occurs in canola. Basal infections of *Sclerotinia* in canola can be caused by two different *Sclerotinia* species: *S. sclerotiorum* and *S. minor*. The main difference between the two types of *Sclerotinia* are the size of the sclerotia – *S. sclerotiorum* has larger sclerotia that resemble rat droppings, while *S. minor* has much smaller sclerotia that resemble shrunken canola seeds that are usually found clumped together. Basal infections of *Sclerotinia* can be seen in a canola field before flowering starts.

DISEASE LEVELS IN NSW

A *Sclerotinia* disease survey was done in the major canola growing regions of NSW around the Albury, Lockhart, Wagga Wagga, Temora, Cootamundra and Young agricultural districts during 1998, 1999 and 2000. Petal infestation levels (inoculum on petals before infection) and the level of stem lesions before harvest were recorded. Petal infestation levels ranged from 0 to 99.4%, while disease levels ranged from 0 to 37.5% of plants. Consideration of such levels will better help growers to make decisions on the use and timing of fungicides in future seasons. Guidance for decisions is discussed below.

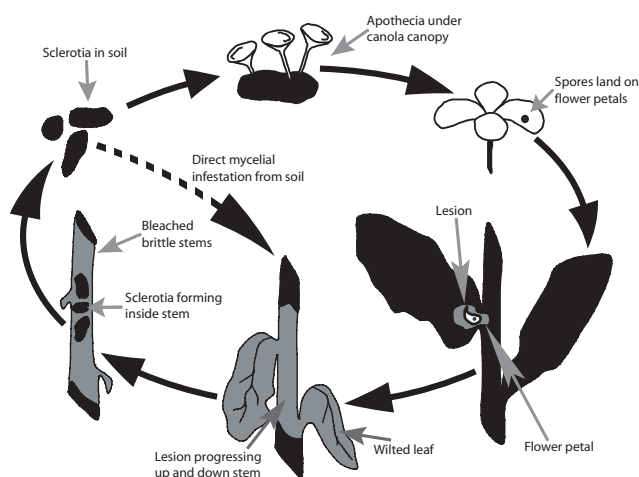
MANAGEMENT OPTIONS

Current management options are limited to stubble burning, rotations, cultural methods and the use of fungicides. Future options for managing the disease may include resistant varieties and biological control.

Stubble burning

Burning stubble is a common disease control practice in many countries. Preliminary research

The disease cycle



in NSW has revealed that the survival of sclerotia can be reduced at temperatures of 93°C, but a temperature of 121°C is needed to kill all sclerotia.

Stubble fires, particularly canola stubble fires, can burn very unevenly. Cereal stubbles burn better than canola stubble, but even they do not have the consistent or uniformly high temperatures needed to kill all sclerotia. Experiments examining survival of sclerotia in stubble fires have given mixed results.

In two recent experiments in southern NSW, the temperatures recorded in stubble fires were not high enough to reduce the survival of sclerotia. Temperatures of above 121°C occurred in 0% and 6% of sites while temperatures above 93°C were observed in only 2% and 8% of sites respectively. Therefore stubble burning cannot be recommended as a method for controlling *S. sclerotiorum* in canola or the cropping rotation.

Rotations and resistant varieties

As *Sclerotinia* has a wide host range (including weeds) and the sclerotia survive in the soil for several years, it is difficult to control by crop rotation. Further, there is no resistance in Australian canola varieties. Canola researchers in Canada are attempting to use a Chinese variety with *Sclerotinia* resistance in their breeding program; if this shows promise, resistance will be incorporated into Australian varieties, but this is several years away.

Cultural management

There are several overseas cultural practices that could be implemented in Australia to help reduce the risk of infection.

- Use of good quality seed that is free of sclerotia. Although there is no canola seed certification for *Sclerotinia* in Australia, careful inspection of seed before sowing would indicate if high levels of sclerotia were present.
- A three to four year break between canola crops and other susceptible crops. *Sclerotinia* does not affect cereals, and sclerotia levels usually decline in the absence of a host. However, while this may be useful overseas it is thought that spores blow across districts and between crops. This requires further investigation.
- Control of broadleaf weeds during the rotation. Most broadleaf weeds are hosts for the disease.
- Deep ploughing of stubble. Burial of sclerotia 8 cm below ground level can be an effective method of reducing sclerotia. However, live

sclerotia can be ploughed up the following year due to their longevity. In southern regions of NSW this method is unlikely to be popular where direct drilling has been promoted to prevent soil erosion and to protect soil structure.

- Avoiding sowing canola next to a field that was heavily infected with Sclerotinia the previous year.

Fungicides

Yield losses in crops overseas are reduced by the timely application of fungicides during flowering. In Australia, Rovral® Liquid Fungicide is currently registered for control of Sclerotinia on canola crops at 2 L/ha. Other fungicides are currently being considered for registration.

USE OF FUNGICIDES TO CONTROL SCLEROTINIA STEM ROT

Economics of spraying

Due to the sporadic nature of stem rot, it is important to determine the economic feasibility of fungicide application. It has been considered uneconomical to apply fungicides routinely, and to be effective they need to be applied before the plant becomes infected. Before applying a fungicide, consider the current price of both chemical and canola to determine the viability of Sclerotinia control. For example:

Rovral Liquid Fungicide (2 L/ha)	\$31/L	\$62
Aerial spraying	\$17/ha	\$17
Cost/ha (January 2004)		\$79

After determining current prices, the Canadian rule of thumb is used to determine yield loss from Sclerotinia infection: Yield loss = ½ (Percent Sclerotinia stem rot). You would expect a yield reduction of about 10% if 20% of plants are infected with Sclerotinia stem rot. The table below will help you to decide the level of Sclerotinia infection that would justify a fungicide application.

The data in the table show:

- A yield loss of about 15% would be required to break even and justify using Rovral.
- This would represent 30% stem rot in the crop, which would be considered a high disease level.
- Based on a 2 t/ha crop and with canola prices at \$350/t, the above table shows a \$26/ha return would have been achieved had Rovral been applied.
- Returns from the use of Rovral® increased when yield losses were greater than 15% and when canola returns increased from \$350t/ha to \$400t/ha.

Timing of fungicide application

The current recommendation is to apply fungicide at between 20% and 50% flowering (see 'Assessing percent flowering in canola' in this Agnote). Further research by NSW Agriculture aims to better define the most appropriate stage of flowering for fungicide application.

Basal infections of Sclerotinia

As basal infections of Sclerotinia occur below the soil line they are unlikely to be as responsive to fungicide application as aerial infections of Sclerotinia. Further work is needed to determine if fungicides would be able to reduce basal infections of Sclerotinia.

Returns from the use of Rovral fungicide for Sclerotinia control. Net returns from Sclerotinia control with Rovral are based on a 2 t/ha potential yield and chemical and application costs of \$79/ha.

% yield loss	yield loss (t/ha)	On Farm Price Canola (\$/tonne)					
	at 2 t/ha potential	\$350/t	\$360/t	\$370/t	\$380/t	\$390/t	\$400/t
5	0.1	-\$44	-\$43	-\$42	-\$41	-\$40	-\$39
10	0.2	-\$9	-\$7	-\$5	-\$3	-\$1	\$1
15	0.3	\$26	\$29	\$32	\$35	\$38	\$41
20	0.4	\$61	\$65	\$69	\$73	\$77	\$81
25	0.5	\$96	\$101	\$106	\$111	\$116	\$121
30	0.6	\$131	\$137	\$143	\$149	\$155	\$161

SCLEROTINIA DISEASE FORECASTING AND PETAL TESTING

Several different Sclerotinia forecasting tools are currently used overseas to predict the risk of Sclerotinia infection in canola. These systems rely on weather data, crop history and spore presence but are not easily adaptable to Australian conditions, particularly as our crops flower for a much longer period of up to 6 weeks, compared with 3 weeks in Canada.

Petal testing

The forecasting system developed in Canada, called 'The petal testing kit', has been trialled in Australia. Based on testing flower petals for the presence of Sclerotinia, the test estimates that the % of stem rot at the end of the season will be equivalent to half the % of petal infestation.

Testing under NSW conditions found no relationship between % infected petals and % stem rot over three years in 101 canola crops (Figure 1). In NSW the actual % stem rot was usually less than the incidence predicted by the Canadian model.

Is the petal test useful?

Although no relationship was found between % petal infestation and % stem rot, testing petals for Sclerotinia is still useful because it provides two things.

- An indication of the presence or absence of the disease, as petal infestation is required for disease development. Stem rot has not been recorded without prior petal infestation.

- An upper limit for disease development in your field. Field studies show that disease levels are unlikely to exceed the level of petal infestation. That is, a 20% petal infestation can result in a stem rot level between 0 and 20% because disease development depends on seasonal conditions after the petal test. Therefore, a low upper limit of disease would enable the farmer to decide not to spray since disease development is not likely to be high enough for economic control.

Petal test now available

The petal test is now being offered to growers and agronomists through NSW Agriculture's Plant Health Diagnostic Service. Canola petals collected at 20–30% flowering are tested for the presence of Sclerotinia. The petal test provides a guide to the range of losses that Sclerotinia may cause.

THE PETAL TEST

Cost

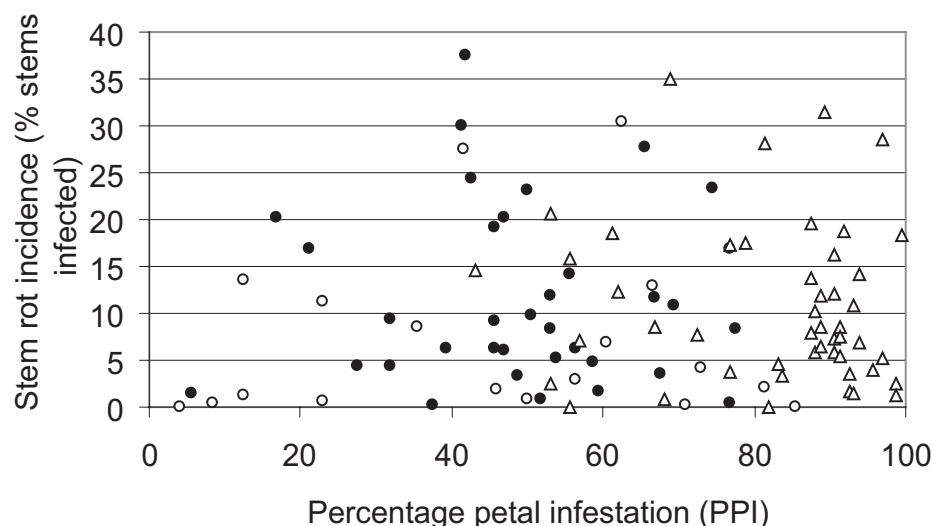
The charge for a single test (5 samples from one crop, see below) is \$223.45 (August 2004). Charges for multiple tests can be negotiated.

Timing of test

Petal sampling should be done at 20–30% flowering. This is:

- when the crop has just covered over in yellow (usually about 2 weeks from seeing the first canola flowers from the roadside),
- when the majority of main stems have at least 14–16 open flowers,
- when 90% of all plants have a flower.

Figure 1 Relationship between percent petal infestation and stem rot incidence in canola fields around southern New South Wales in ○ 1998 (18), ● 1999 (35), and △ 2000 (48). Numbers in brackets indicate the number of fields sampled each year.



Refer to the guide on the following pages when assessing the percent flowering in canola.

Petal sampling at 20–30% flowering allows enough time for sample processing (4 days) before deciding on whether to apply a fungicide.

Assessing percent flowering in canola

Before assessing the percent flowering in canola remember that factors such as the time of day and canola variety can alter the appearance of the crop. This guide represents the progress of flowering from 10% to 60% flowering at 10% intervals. Weather conditions during flowering will influence the speed at which each 10% interval is reached.

Important tips before sampling

- Avoid sending a sample on a Thursday/Friday (samples deteriorate quickly).
- If 20–30% flowering occurs on Thursday/Friday wait until Sunday to take a sample (refrigerate and send on Monday).
- *Do not freeze samples.*
- Avoid keeping samples for more than one night (refrigerate if kept overnight).
- Avoid sampling after rainfall (wet samples deteriorate quickly).
- Avoid edge effects by taking a sample a couple of metres in.

Sampling the crop

Take 5 samples from around the paddock.

- Each sample should be about 50 paces or 50 metres apart.
- Each sample should comprise 5 stems with >10 open flowers (making 25 stems in total).
- Place petals from each sample into a plastic bag for postage (if possible keep the samples separated).

Sending the sample

Using the Plant Health and Insect Diagnostic submission form, include the following details:

- your name
- contact numbers (phone, fax, email)
- address
- location where sample was collected

When using the PHDS form, mark under 'Problem' that you require a petal test.

The Plant Health and Insect Diagnostic submission form can be found on the NSW Agriculture internet site at <http://www.agric.nsw.gov.au/reader/6506>.

Post your sample as soon as possible

Where to send the sample

Samples should be addressed to:

(PHDS) Petal testing
Wagga Wagga Agricultural Institute
PMB Wagga Wagga
NSW 2650

AUSTRALIAN FORECASTING SYSTEM DEVELOPMENT

Petal infestation

A preliminary forecasting system developed between 1998 and 2000 found a relationship between weather conditions and % petal infestation in the 4 weeks before petal testing. The more days with rain (> 2 mm) the greater the % petal infestation, and the higher the temperature the lower the % petal infestation. This model is being refined with the use of data loggers placed in the field to pick up microclimate influences under the canola canopy. It will be a useful indicator of the need for a petal test.

FURTHER INFORMATION

Canola Council of Canada. Canola Connection: The growers manual [Online]. <http://www.canola-council.org/production/candisea.html>

Alberta Agriculture Food and Rural Development. Plant Diseases [Online]. <http://www.agric.gov.ab.ca/navigation/pests/plantdiseases/index.html>

Gregorie T, Berglund D, Lamey A (2001). Canola Flowering and Fungicide Application Times [Online] A-1208. <http://www.ext.nodak.edu/extpubs/plantsci/crops/a1208w.htm>

Rimmer SR, Buchwaldt L (1995). Diseases. In: Kimber DS, McGregor DI (eds), *Brassica Oilseeds*. CAB International, Wallingford, pp 111-140.

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The information contained in this publication is based on knowledge and understanding at the time of writing (August 2004). However, because of advances in knowledge, users are reminded of the need to ensure that information upon which they rely is up to date and to check currency of the information with the appropriate officer of New South Wales Department of Agriculture or the user's independent adviser.



Photos supplied courtesy of BASF.

10% flowering – there are at least 10 open flowers on the main stem.



20% flowering – there are 14–16 open flowers on the main stem.



30 % flowering – there are at least 20 open flowers on the main stem. A crop at 30 % flowering will have only a few pods formed.



40 % flowering – pods are forming but only a few are elongating.



50 % flowering – the crop is at maximum colour development. It will still have a few unopened buds at the top of the main stem and the lower pods will be elongating.



60 % flowering – all of the top buds will have opened. The crop will have begun to change colour from a bright yellow to a dull yellow.