SCLEROTINIA

STAMVROT/STEM ROT

(SCLEROTINIA SCLEROTIORUM)

PROTEÏENNAVORSINGSTIGTING
PROTEIN RESEARCH FOUNDATION

Inhoudsopgawe

Index

Sclerotinia STAMVROT
(*Sclerotinia sclerotiorum*)

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Die voorkoms van *Sclerotinia* het in Australië en Kanada toegeneem met 'n toename in oppervlak onder canola-verbouing. In die Wes-Kaap het die oppervlakte onder canola gedurende die afgelope drie seisoene verdubbel en omdat die klimaat in die Overberg en Swartland baie geskik is vir die ontwikkeling van *Sclerotinia*, het dié siekte baie algemeen in veral die Overberg voorgekom oor die afgelope vier seisoene (2011 tot 2014).

Sclerotinia is 'n siekte wat canola, maar ook baie ander breëblaargewasse infekteer. Lupiene is baie vatbaar en in die Swartland kom dit op lupiene voor, tot in die Eendekuil gebied. Onkruid, soos duwweltjie en ramenas, is ook gashere van die siekte, maar erte en fababone is egter minder vatbaar. *Sclerotinia* stamvrot (**Foto 1**) kom slegs sporadies voor wanneer die klimaatsomstandighede gunstig is vir die ontwikkeling van die siekte en gevolglik wissel dit tussen jare, produksiestreke en selfs van land tot land.

RISIKOFAKTORE

1. Vog

Vog is baie belangrik vir die ontwikkeling van *Sclerotinia*. Hoë grondvoginhoude met ligte reën wat voorkom in die periode twee weke voor die aanvang van blom en gedurende die blomstadium sal die risiko vir *Sclerotinia*-infeksie baie verhoog, terwyl droë klimaatstoestande die ontwikkeling van die siekte sal beperk.

Vog vir die ontwikkeling van *Sclerotinia* kan voorsien word deur reën, dou, mistige weer en selfs 'n hoë relatiewe humiditeit (>80%) in die lug. Aangesien die humiditeit tussen plante in 'n canolaland meestal hoër is as gemeet deur weerstasies, is metings van weerstasies nie noodwendig 'n goeie maatstaf nie. Swaar reënneerslae tydens blomstadium kan die *Sclerotinia*-risiko verminder omdat dit die vrystelling van spore kan verminder deurdat water *Sclerotinia* van die blomblare van die plante afspoel (**Foto 3**).

Foto 1: ***Sclerotiums*** **in die stam van canolaplante.**

Foto 2: *Sclerotinia apothecia* (klein struktuurtjies wat soms kan lyk soos sampioene).

Foto 3: Blomblare teen die stam sal met voldoende vog die ideale omgewing skep vir die ontwikkeling van *Sclerotinia*.

BELANGRIK OM TE WEET

Die risiko is laag ná 'n paar weke van droogte, gevolg deur reën en gevolg deur 'n droë klimaat daarna (min dou). Indien hoë humiditeit en dou ervaar word in die periode ná die reën, het die spore twee weke nodig om te ontwikkel en vrygestel te word uit die *Sclerotinia apothecia* (Foto 2). Indien sodanige toestande laat in die blomstadium voorkom, sal 'n swambespuiting nie meer bydra tot hoër graanopbrengste nie.

2. Temperatuur

Temperatuur is minder belangrik as vog, maar het steeds 'n groot invloed op die siekte. Nag- en vroegoggendtemperature van ongeveer 15°C met swaar dou is ideaal vir die ontwikkeling van *Sclerotinia*. Infeksie vind nie plaas gedurende die hitte van die dag nie, maar wel snags.

Warm dae sal infeksie verminder omdat die geïnfekteerde blomblare uitdroog en van die plant afval. Tydens warm, droë toestande speen die plant sy onderste blare af en indien die blare afval voor die infeksie versprei vanaf die blomblare, sal dit *Sclerotinia* stamvrot beperk.

3. Blaredak

Sclerotinia is hoogs afhanklik van die mikroklimaat in die blaredak van die canolastand.

BELANGRIKE FAKTORE WAT MIKROKLIMAAT BEÏNVLOED

3.1. KULTIVAR

Kultivars wat groter blaaroppervlakte ontwikkel, verhoog die risiko. Daar is meer plek vir blomblare om op te val, terwyl die blare vog vasvang en 'n ideale (humiede) mikroklimaat kan skep. Plante wat hoog groei en maklik omval, is ook meer vatbaar vir *Sclerotinia*.

3.2. BEMESTING

Gronde met 'n hoë voedingstatus se canolaplante het meer en groter blare en gevolglik 'n digter blaredak wat die humiditeit en sodoende die risiko verhoog.

3.3. OMVAL

Plante wat omval, droog nie so vinnig af nie en indien hulle geïnfekteer is, sal die plant-tot-plant-kontak die siekte help versprei.

3.4. PLANTDATUM

Canolalande met verskillende saaidatums se vlakke van infeksie kan verskil. Die voorkoms van *Sclerotinia* stamvrot is afhanklik van die klimaat en blomstadium van die canolaplant. 'n Plantdatum wat teweegbring dat canolaplante blom tydens vogtige toestande en gunstige temperature, kan die voorkoms van die siekte verhoog.

3.5. HOË SAAIDIGTHEID

Hoë saaidigthede het tot gevolg dat plante beter kompeteer met onkruid en meer egalig ryp word, maar het 'n digter blaredak tot gevolg. Digte stand het ook tot gevolg dat stamme dun is en maklik kan omval.

BELANGRIK OM TE WEET

'n Laer plantestand is ook nie immuun teen *Sclerotinia* stamvrot nie. Logika wil vir 'n mens sê dat minder plante per vierkantemeter, meer oop spasies het met 'n minder digte blaredak om vog vas te vang. Dit is egter slegs van toepassing vir lande met min plante en 'n lae opbrengspotensiaal. In 'n laer plantestand het canolaplante groter blare en stingels sowel as 'n langer blomperiode. Dit kan die risiko vir *Sclerotinia* verhoog deurdat blomblare oor 'n langer periode afval en met die groter blare is daar meer plek vir blomblare om op te val.

Wyer rye en laer saaidigtheid kan wel die risiko verlaag, maar dit is afhanklik van klimaatstoestande. Wind beweeg makliker tussen plante wanneer die rye wyer is en droog sodoende plante en grond af. Wyer plantrye sal geen voordeel inhou indien vogtige toestande tydens die blomstadium voorkom nie.

4. Wisselbou

Aangesien die siekte so lank in die grond kan oorleef (tot tien jaar), het wisselbou min invloed op die voorkoms van *Sclerotinia* stamvrot (sien egter lewensiklus en bestuur van die siekte).

RISIKOTABEL

Die risikotabel (**Tabel 1**) wat in Swede ontwikkel is, kan gebruik word om die risiko vir die voorkoms van *Sclerotinia* te bepaal. Die lys moet voltooi word as 75% van die plante drie blomme het (begin van blom). Hoe groter die risiko vir *Sclerotinia*, hoe beter is die kans dat dit ekonomies geregverdig is om chemiese beheer toe te pas. In Swede is gevind dat 'n 40-telling chemiese beheer regverdig, maar dit is afhanklik van die prys van canola en die koste van beheer. Dis belangrik om vir wisselbou 'n minimum van vyf punte te gee aangesien nabygeleë kampe 'n risiko kan inhou.

Die siekte sal steeds voorkom al word daar op die korrekte aanbevole tyd gespuit. Chemiese beheer beperk net die graad van infestasie. Twee bespuitings sal die periode van beskerming verleng, maar sal steeds nie die siekte uitwis indien die siektedruk hoog is nie. **Tabel 2** bevat die lys van geregistreerde swamdoders vir canola.

TABEL 1: *SCLEROTINIA* STAMVROT RISIKOLYS: BEGIN BLOM (75% VAN DIE PLANTE HET DRIE BLOMME).

RISIKOFAKTOR	KATEGORIE	RISIKOPUNT
Wisselbou: Jare ná canola	>6 jaar	0
	3 tot 6 jaar	5
	1 tot 2 jaar	10
Sclerotinia-voorkoms in die laaste gasheergewas, soos canola, lupiene ensovoorts.	Geen	0
	Laag (1% - 10%)	5
	Matig (10% - 30%)	10
	Swaar (31% - 100%)	15
Saaidigtheid (plantestand)	Laag	0
	Medium	5
	Hoog	10
Reën in die laaste twee weke	<10 mm	0
	10 mm - 30 mm	5
	>30 mm	10
Weervoorspelling	Droog	0
	Wisselvallig	10
	Goeie kans vir reën	15
Plaaslike risiko vir die ontwikkeling van *Sclerotinia apothecia*	Geen gevind	0
	Lae getalle	10
	Hoë getalle	15

http://www.canolawatch.org/2013/01/09/sclerotinia-stem-rot-management/

TABEL 2: SWAMDODERS VIR CANOLA.

EIENSKAPPE/AKTIEWE BESTANDEEL	**SCORE** *Difenkonasool*	**AMISTAR XTRA** *Asoksistrobien Siprokonasool*	**PROSARO 250EC** *Prothiokonasool Tebukonasool*
Volume water	250 g/l	200 g/l & 80 g/l	125 g/l & 125 g/l
Lug l/ha Grond l/ha	 300	 200 - 450	30 - 40 300
WERKSWYSE	Sistemies	Sistemies	Sistemies
Registrasie +Dosis/ha *Alternaria* *(Alternaria spp.)*	 500 ml (g)	 1 000 ml (g) - 2 000 ml (g)	 Geen
Swartstam *Leptosphaeria maculans*	500 ml (g)		630 ml (g) - 760 ml (g) 630 ml (l) - 760 ml (l)
Sclerotinia stamvrot		1 000 ml (g) - 2 000 ml (g)	630 ml (g) - 760 ml (g) 630 ml (l) - 760 ml (l)

NB: Lys is moontlik nie volledig nie. Volg die etiket van die produk (nuwe registrasies kan in die toekoms bygevoeg word).

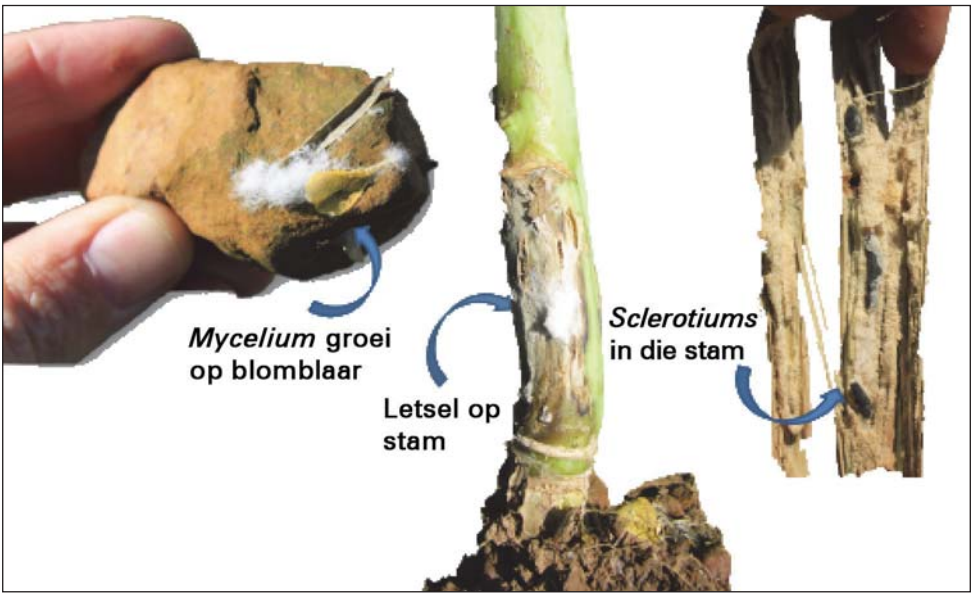
WANNEER OM CHEMIESE BEHEER TOE TE PAS

Blomblare is die teiken. Chemiese beheer is nie effektief voor blomstadium nie. Chemiese middels genees nie infeksie nie, maar voorkom dat die spore op die blomblare ontkiem nadat dit op die blare geval het. Dit is makliker om blomblare te benat met 'n chemiese middel terwyl die plant nog blom. Gevolglik is dit die mees geskikte tyd vir chemiese beheer.

Die tydsberekening van chemiese beheer moet binne die 20% - 50%-blomstadium geskied (sommige produkte is geregistreer vir slegs die 20% - 30%-blomstadium. Lees die produketiket). By die 20%-blomstadium het geen blomblare nog afgeval nie. Canola kan binne vier tot vyf dae die 20%-blomstadium bereik. Berei vroegtydig voor om die *Sclerotinia*-risiko te bepaal. 'n Bespuiting by die 20% - 30%-blomstadium verseker dat baie blomme reeds oop is en hulle word met 'n produk benat voordat hulle val. 'n Laat bespuiting kan slegs effektief wees as dit aanvanklik droog was, gevolg deur reën tydens die 40% - 50%-blomstadium; en slegs as plante herstel ná droogte of hitte, wat gevolglik die blomperiode verleng. Dit is egter selde meer effektief as beheer tydens die 20% - 30%-blomstadium.

IDENTIFIKASIE VAN *SCLEROTINIA* STAMVROT

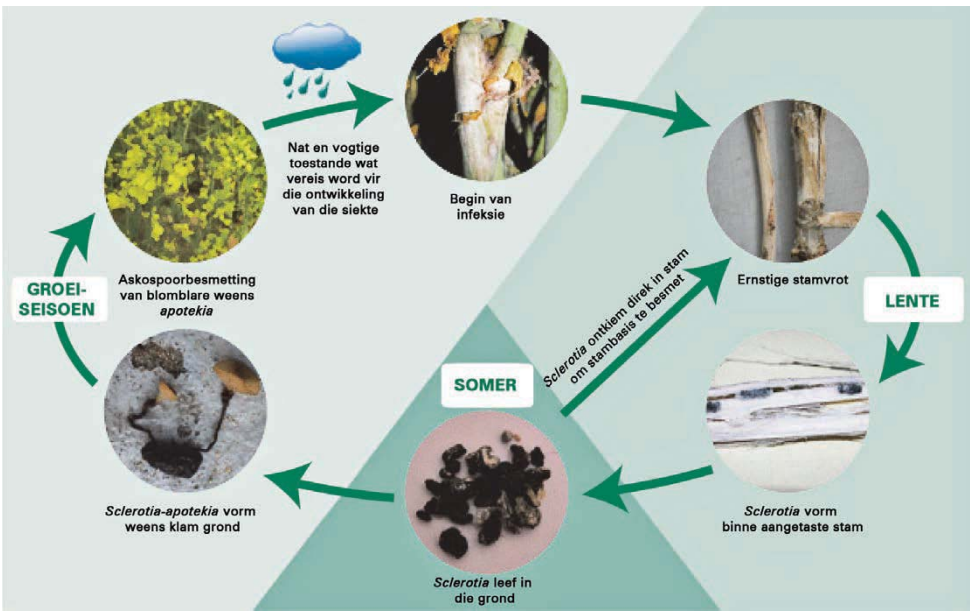
- *Sclerotinia apothecia* vorm in die winter op *Sclerotiums*. Dit lyk soos klein sampioene in 'n gholfpennetjievorm (**Figuur 1**).
- Wit wollerigheid (*mycelium*) kom voor op die stam van die plant (Figuur 1).
- Plant hou op om te groei bo die punt van infeksie. Die vaatweefsel word beskadig deur die swam en die plant kan nie water en voedingstowwe opneem nie.
- Die geaffekteerde deel van die plant is grys-wit of bruin-wit van kleur (Figuur 2).
- Swart-bruin *Sclerotiums* (lyk soos muismis), van tot 15 mm lank, vorm binne en op die stam (Figuur 1).



Figuur 1: Simptome van *Sclerotinia*.

LEWENSIKLUS

- Tydens gunstige toestande vorm klein struktuurtjies wat soms kan lyk soos sampioene (*apothecia*) op die *sclerotiums* en van daar word spore vrygestel wat met die wind versprei (Foto 2). Die spore word tien tot 14 dae na *apothecia* gevorm het, vrygestel. Die ideale temperatuur vir *apothecia* om te ontwikkel, wissel tussen 11°C en 15°C.
- Die spore ontkiem op die ou blomblare wat as voedsel dien.
- Besmette blomblare val op die blare of teen die stam waar die *mycelium* die plant binnedring en besmet.
- Klimaat tydens blom speel 'n belangrike rol in die ontwikkeling van die siekte en dit benodig vogtige toestande. Die optimum temperatuur vir ontwikkeling is 15°C maar sal ontwikkel tot 25°C as voldoende vog beskikbaar is.
- *Sclerotiums* vorm in die stam van die plant en kan drie tot vier jaar in die boonste 5 cm van die grond oorleef en tot tien jaar indien dieper ingewerk word. *Apothecia* vorm slegs op *sclerotiums* wat in die boonste paar sentimeter van die grond voorkom wanneer die klimaat gunstig is.



Figuur 2: Lewensiklus van *Sclerotinia* in canola.
https://www.agric.wa.gov.au/canola/managing-Sclerotinia-stem-rot-canola?page=0%2C1

BESTUUR

1. Volg vierjaar-rotasie met nie-vatbare gewasse (grane). Lupiene is selfs meer vatbaar vir *Sclerotinia* as canola, en *sclerotiums* kan tot tien jaar in die grond oorleef indien dit dieper (>5 cm) in die grond voorkom.
2. Aangrensende lande is belangrik: Hou die geskiedenis van die land en die huidige gewas in gedagte. Indien moontlik, plant 500 m weg van voorheen geïnfekteerde lande.
3. Plant vatbare gewasse wind-op van die besmette area na gelang van heersende winde.
4. Daar is geen kultivar in Suid-Afrika beskikbaar met weerstand teen *Sclerotinia* nie.
5. Skoon saad moet gesaai word. *Sclerotiums* kan tydens oes by saad beland.
6. Wyer plantrye kan lugvloei bevorder en plante droog vinnig af.
7. Evalueer die seisoen as die plante begin blom. Voltooi die *Sclerotinia* stamvrot risikolys en bepaal die risiko van die gewas.
8. Beheer breëblaar-onkruide, soos duwweltjie en ramenas, aangesien dit ook gashere is vir die siekte.
9. Na-aanplanting is chemiese beheer die enigste opsie om die siekte te beheer. Die koste van bespuiting moet opgeweeg word teen die opbrengsverhoging en prys van canola.
10. Swambeheer moet toegepas word voor infeksie sigbaar is (gebruik die *Sclerotinia* stamvrot risikolys en bepaal die risiko).
11. Die beste stadium vir chemiese beheer is 20% - 30% blom (volg aanduidings op produketiket).
12. ‘n Minimum van 100 liter water per hektaar moet verkieslik saam met die chemiese middel gespuit word. Chemiese middels het slegs ‘n effek vir ‘n beperkte periode. Bepaal wat dit is en oorweeg koste voor ‘n opvolgspuit gedoen word.
13. Die norm wat aanvaar word om verliese te bereken is ‘n 0,5%-verlies in opbrengs vir elke 1%-plantinfeksie. By swaar infeksies beweeg dit nader aan ‘n verhouding van 1:1.

BRONNE

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Sclerotinia STEM ROT
(*Sclerotinia sclerotiorum*)

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The incidence of *Sclerotinia* in Australia and Canada increased, according to the increased surface area planted under canola. In the Western Cape, the area planted under canola increased three-fold over the past three seasons. The climate in the Overberg and Swartland is very favourable for the development of the disease and it is a general problem, particularly in the Overberg, becoming an increasing problem over the past four seasons (2011 to 2014).

Sclerotinia is a disease that affects canola, but also many other broad-leaf crops. Lupins are very susceptible to *Sclerotinia* and in the Swartland it affects lupins, even up to the Eendekuil area. Weeds such as devil's thorn and ramenas are hosts of the disease, but peas and faba beans are less susceptible. *Sclerotinia* stem rot (**Photo 1**) only appears sporadically when climatic conditions are favourable for the development of the disease. As such, the occurrence varies between years, production areas and even from field to field.

RISK FACTORS

1. Moisture

Moisture is very important for the development of *Sclerotinia*. High soil moisture contents following light rain that occurs during the two-week period before the onset of the flowering stage and during the flowering stage increase the *Sclerotinia* infection risk significantly. Dry climatic conditions limit the development of the disease.

Moisture for the development of *Sclerotinia* may be provided by rain, dew, misty weather and even relatively high surrounding humidity (>80%). Normally humidity measured between plants in a canola field is higher than the humidity measured by weather stations. As such, weather station measurements are not good guidelines. Heavy rainfall during the flowering stage may reduce the *Sclerotinia* risk because it may hamper the release of spores. Water covers *Sclerotinia* and rinses it from flower petals and plants (**Photo 3**).

Photo 1: *Sclerotiums* in stalks of canola plants.

Photo 2: *Sclerotinia apothecia* (small structures often looking like mushrooms).

Photo 3: Flower petals against the stem will, with sufficient moisture, create the ideal environment for the development of *Sclerotinia*.

IMPORTANT TO KNOW

After a few weeks of drought, followed by rain, followed by a dry climate (little dew), the risk is low. In cases of high humidity and dew following rain, the spores need two weeks to develop and to be released from the *Sclerotinia apothecia* (Photo 2). If such conditions develop late in the flowering stage, spraying for fungi will no longer contribute to high grain yields.

2. Temperature

Temperature is not as important as moisture, but has a significant effect on the disease. Night and early morning temperatures of about 15°C with heavy dew are ideal for the development of *Sclerotinia*. Infection happens at night, not during the heat of the day.

Warm days will reduce infection because the infected flower petals dry out and drops from the plant. During hot, dry conditions the plant sheds its bottom leaves. If the leaves drop before the infection spreads from the flower petals, it will limit the development of *Sclerotinia* stem rot.

3. Leaf cover

Sclerotinia highly depends on the micro-climate in the leaf cover of the canola plants in the field.

IMPORTANT FACTORS THAT INFLUENCE MICRO-CLIMATE

3.1. CULTIVAR

Cultivars that develop larger leaf surfaces increase the risk. Broader leaves allow bigger catch areas for flower petals, while the leaves capture moisture, creating an ideal (humid) micro-climate. Plants that grow high with a high probability of toppling over are also more susceptible to *Sclerotinia*.

3.2. FERTILISING

Soil with a high nutritional status gives rise to canola plants with more and larger leaves. As such, the leaf cover is denser, leading to higher humidity and a subsequent higher risk of *Sclerotinia*.

3.3. TOPPLING OVER

Plants that topple over do not dry as quickly and if those plants are infected, plant-to-plant-contact will contribute to the spreading of the disease.

3.4. PLANTING DATE

Canola fields with varied sowing dates may lead to varied levels of infection. The incidence of *Sclerotinia* stem rot depends on the climate and flowering stage of the canola plant. Planting dates that lead to canola flowering during moist conditions and favourable temperatures, could lead to an increased incidence of the disease.

3.5. HIGH SOWING DENSITY

High sowing densities mean that plants compete better with weeds and ripen more evenly, but it leads to a denser leaf cover. A higher plant density also means that plants have thinner stems and topple over more easily.

IMPORTANT INFORMATION

Lower plant densities do not create immunity against *Sclerotinia* stem rot. It is logical to say that fewer plants per square metre mean more open spaces and a reduced leaf cover to capture moisture. This applies only to fields with few plants and a low yield potential. In cases of lower plant densities, canola plants have larger leaves and bigger stems, as well as a longer flowering period. This may increase the risk of *Sclerotinia* because flower petals drop over a longer period. Larger leaves also provide larger surfaces to catch flower petals when they drop.

Wider rows and lower sowing densities could also reduce the risk, but depends on climatic conditions. Wind moves more easily between plants if rows are wider. It improves drying the plants and soil. Wider plant rows provide no benefits if moist conditions arise during the flowering stage.

4. Rotational crops

The disease can survive in soil for a significant time (up to ten years) and therefore rotational crops have little or no effect on the incidence of *Sclerotinia* stem rot (however, refer to the information on the life cycle and management of the disease).

RISK TABLE

The risk table (**Table 1**) developed in Sweden, may be used to determine the *Sclerotinia* risk. The list must be completed when 75% of the plants have three flowers (beginning of the flowering stage). The bigger the *Sclerotinia* risk, the better are the chances that it may be economically justified to apply chemical control. Sweden found that a count of 40 justifies chemical control, but justification depends on the canola price and the control costs. It is important to give rotational crops a minimum of five points, as fields within the same vicinity may pose a risk.

The disease will still occur, even if spraying is done at the recommended time. Chemical control only limits the degree of infestation. Two sprayings increase the period of protection, but it will not eradicate the disease if the disease pressure is high. **Table 2** shows the list of registered canola fungicides.

TABLE 1: *SCLEROTINIA* STEM ROT RISK LIST: BEGINNING OF FLOWERING STAGE (75% OF PLANTS HAVE THREE FLOWERS).

RISK FACTOR	CATEGORY	RISK POINT
Rotational crop: Years after canola	>6 years	0
	3 to 6 years	5
	1 to 2 years	10
Sclerotinia incidence in the last host crop, e.g. canola, lupins, etc.	None	0
	Low (1% - 10%)	5
	Moderate (10% - 30%)	10
	Severe (31% - 100%)	15
Sowing density (plant density)	Low	0
	Moderate	5
	Severe	10
Rain in the past two weeks	<10 mm	0
	10 mm - 30 mm	5
	>30 mm	10
Weather forecast	Dry	0
	Varied	10
	Good chance of rain	15
Local risk for the development of *Sclerotinia apothecia*	None found	0
	Low numbers	10
	High numbers	15

http://www.canolawatch.org/2013/01/09/sclerotinia-stem-rot-management/

TABLE 2: CANOLA FUNGICIDES.

CHARACTERISTICS/ ACTIVE INGREDIENT	**SCORE** *Difenkonazol*	**AMISTAR XTRA** *Azoxystrobin Cyproconazole*	**PROSARO 250EC** *Prothioconazole Tebukonazol*
Volume water	250 g/l	200 g/l & 80 g/l	125 g/l & 125 g/l
Air l/ha Soil l/ha	 300	 200 - 450	30 - 40 300
ACTION	Systemic	Systemic	Systemic
Registration + dosage/ha *Alternaria (Alternaria spp.)*	500 ml (g)	1 000 ml (g) - 2 000 ml (g)	None
Blackleg *Leptosphaeria maculans*	500 ml (g)		630 ml (g) - 760 ml (g) 630 ml (l) - 760 ml (l)
Sclerotinia stem rot		1 000 ml (g) - 2 000 ml (g)	630 ml (g) - 760 ml (g) 630 ml (l) - 760 ml (l)

NB: List may not be complete. Read the label and follow the instructions. (New registrations may be added in future.)

WHEN TO APPLY CHEMICAL CONTROL

Flower petals are the targets. Chemical control is not effective before the flowering stage. Chemical substances do not cure the infection, it prevents the spores from germinating on the flower petals after the petals dropped and fell on the leaves. It is easier to saturate flower petals with a chemical substance while the plant is still flowering. As such, this is the best time to apply chemical control.

Chemical control timing must be within the 20% - 50% flowering stage. (Some products are registered only for the 20% - 30% flowering stage. It is therefore important to read the label.) At the 20% flowering stage no petals have been dropped. Canola may reach the 20% flowering stage within four to five days. Prepare early to determine the *Sclerotinia* risk. Spraying at the 20% - 30% flowering stage ensures that flowers have opened and that they are saturated with the product before they drop. Late spraying is effective only after being dry initially, followed by rain at the 40% - 50% flowering stage; and only if plants recover after drought or heat that increases the flowering period. However, it is seldom more effective as control, compared to control during the 20% - 30% flowering stage.

IDENTIFICATION OF *SCLEROTINIA* STEM ROT

- *Sclerotinia apothecia* form in the winter on *Sclerotiums*. It looks like small mushrooms with a golf tee shape (**Figure 1**).
- A white, woolly substance (mycelium) grows on the plant stem (Figure 1).
- Plant stops growing above the infection point. The fungus damages the plant tissue, preventing the plant from taking up water and nutrients.
- The affected part of the plant is grey/white or brown/white (**Figure 2**).
- Black/brown *Sclerotiums* (looks like mice excretions) form inside and on the stem. The *Sclerotiums* are about 15 mm in length (Figure 1).

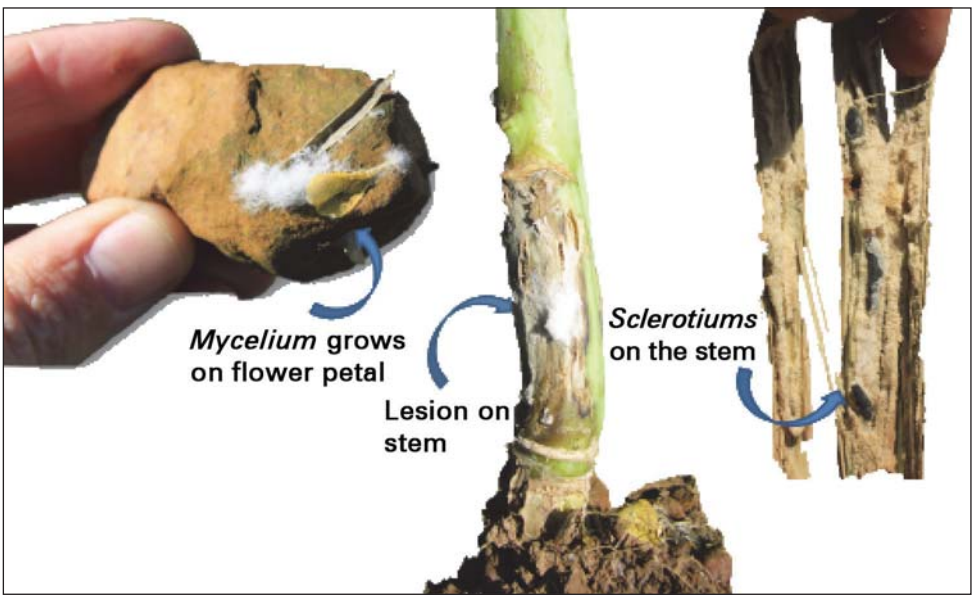

Figure 1: *Sclerotinia* symptoms.

LIFE CYCLE

- During favourable conditions, small structures that look like mushrooms (*apothecia*) form on the *sclerotiums* and release spores that are spread in the wind (Photo 2). The spores are released ten to 14 days after the *apothecia* formed. The ideal temperatures for the development of *apothecia* vary between 11°C and 15°C.
- The spores germinate on the old flower petals that serve as food.
- Infested flower petals fall on leaves or against stem where the *mycelium* enters and infects the plant.
- Climate during flowering stage plays an important role in the development of the disease and it requires moist conditions. The optimal temperatures for development is 15°C, but may develop up to 25°C if sufficient moisture is available.
- *Sclerotiums* form in the stem of plants and may survive for three to four years in the upper 5 cm of the soil and up to ten years if tilled in deeper. *Apothecia* form only on *sclerotiums* that appear in the upper few centimetres of soil, if the climate is favourable.

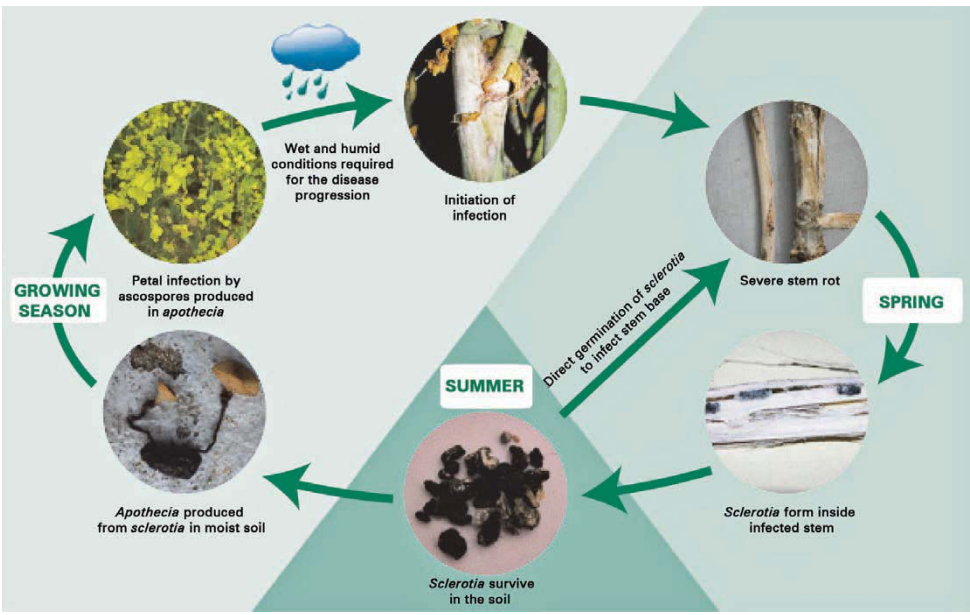

Figure 1: Life cycle of *Sclerotinia* in canola.
https://www.agric.wa.gov.au/canola/managing-Sclerotinia-stem-rot-canola?page=0%2C1

MANAGEMENT

1. Follow a four-year rotation with crops that are not susceptible (grains). Lupins are even more susceptible to *Sclerotinia* than canola. *Sclerotiums* may survive for up to ten years in the soil on deeper (>5 cm) soil levels.
2. Adjoining fields are important. Bear in mind the history of the fields and the current crop. If possible, plant more than 500 metres away from a field that was infected in the past.
3. Plant susceptible crops in the opposite wind direction of the infected field, based on current wind trends.
4. No *Sclerotinia* resistant cultivars are available in South Africa.
5. Sow clean seed. *Sclerotiums* may be included in seeds during harvesting.
6. Wider plant rows may improve air flow and help plants to dry off quicker.
7. Evaluate the season when plants begin flowering. Complete the *Sclerotinia* stem rot risk list and determine the risks for the crop.
8. Control broad-leaf weeds such as devil's thorn and ramenas, as those are hosts for the disease.
9. After planting, chemical control remains the only option to control the disease. The cost of spraying must be considered in terms of the increase in yield and the canola price.
10. Apply fungicides before infection becomes visible (use the *Sclerotinia* stem rot risk list to determine the risk).
11. The best stage for chemical control is 20% - 30% flowering (follow the instructions on the product label).
12. At least 100 litres of water must be sprayed with the chemical substance per hectare. Chemical substances are effective for limited periods only. Determine the period and consider the costs before applying a follow-up spraying.
13. The acceptable norm to determine loss is 0,5% yield loss per each 1% of plant infection. For severe infections the ratio is closer to 1:1.

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