Control of Sclerotinia diseases

Sclerotinia diseases cause major loss in many horticultural crops (e.g. lettuce, beans, carrots, brassicas and peas). Intense cropping and the use of Sclerotinia susceptible crops in rotations have led to a build up of Sclerotinia in soil.

There are new control options that have the potential to contribute to, when integrated with other control measures, improved and sustainable control of Sclerotinia lettuce drop, and other diseases caused by *S. minor*. These options include:

- non-chemical controls (e.g. biological control agents, biofumigant rotation crops)
- cultural strategies (e.g. rotation crops tolerant to Sclerotinia infection)
- procymidone, while an effective fungicide, has recently been withdrawn from use. Boscalid (Filan™) is a suitable alternative

Lettuce drop caused by Sclerotinia.

There are two species of Sclerotinia that cause Lettuce drop.

- *S. minor* usually infects through mycelium that comes in contact with lower leaves and stems. On rare occassions it also produces aerial spores.
- *S. sclerotiorum* usually infects through aerial spores landing on flowers and senescent or damaged tissues. The fungus spreads from these infected flowers or tissues to healthy leaves or stems. Sclerotia of *S. Sclerotiorum* can also produce mycelium, which can directly infect lower leaves and stems. In some places the pathogen is more aggressive under hot and humid conditions (eg Queensland).

Wet conditions favour disease development of both species and they can both cause disease on brassica crops (watery soft rot). Both species produce resting bodies (sclerotia) on infected tissue, which can survive in soil for up to 5 years (*S. minor* size up to 3 mm, *S. sclerotiorum* 5 - 15 mm).

S. sclerotiorum requires humid conditions to develop the fruiting bodies (apothecia) that produce aerial spores. *S. sclerotiorum* also infects carrots (soft rot), green and dry beans (white mold) and many other horticultural crops.

The Bottom line

- **Resting Sclerotinia bodies can survive for 5 years or more.**
- **Biofumigant green manure crops and crops more tolerant to Sclerotinia infection should be used to reduce and prevent build-up of Sclerotinia.**
- **The fungicide boscalid is a suitable replacement for procymidone, recently withdrawn from use.**
- **Better application, timing of fungicide sprays and the right volume of water is essential for effective disease control.**

Fungicides are the most common means of controlling Sclerotinia diseases. However, there is increasing pressure to produce vegetables with minimum to zero pesticide input and there are few fungicides currently registered for control of *S. minor* and *S. sclerotiorum* in Australia.

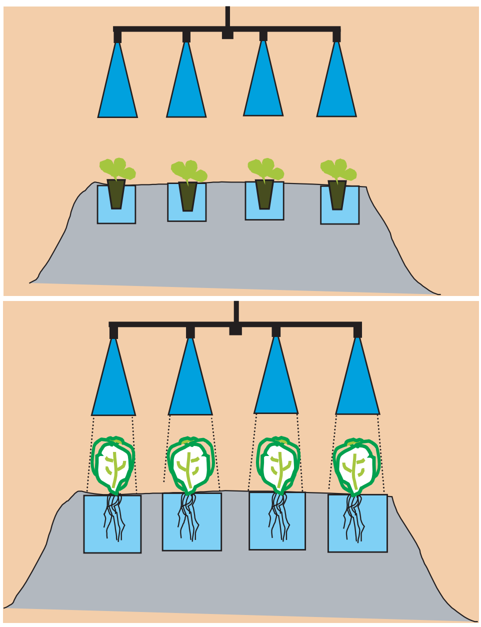
Note: Information on sclerotia numbers can be used as a general guide to predict the level of disease pressure in a given field and select the most appropriate strategy for disease control.

Action: Keep records of history of Sclerotinia disease and crops grown in each field. Use the records to help you select the most appropriate method of disease control.

The integration of non-chemical controls (e.g. biocontrol agents) and cultural strategies (e.g. biofumigation crops, rotation crops, soil amendments), in addition to fungicide applications, to control Sclerotinia diseases is essential to the sustainability of the horticultural industries.

Fungicides

The efficacy of registered fungicides is greatly affected by disease pressure, weather conditions, method of application, overuse and crop canopy size. Research in Victoria and Tasmania tested a range of fungicides for Sclerotinia control and found that boscalid (Filan ™) was an effective replacement for procymidone.



Strategic application provides a more reliable pattern and should be directed at the root zone and under leaves.

In fields with high incidence of Sclerotinia, two to three applications of registered fungicides at transplanting and repeated at a two week interval can be effective in controlling lettuce drop caused by *S. minor*. In low disease pressure sites, two applications of fungicide can provide excellent disease control.

Fungicides must be directed at the base of young plants and repeated before plants become too large. Irrigation after spraying can help to distribute the fungicide into soil and around the base of plants. For *S. sclerotiorum* (airborne spores), fungicides should be applied preventatively at flowering, ensuring good coverage of all flowers.

Biological control agents

Biocontrol agents have been proposed as potential alternatives to fungicides. Biocontrols are fungi or bacteria, commercially formulated, which can destroy *S. minor* sclerotia.

These agents use mechanisms such as competition for nutrients and space, production of antimicrobial chemicals (antibiosis) and parasite sclerotia in soil (specialised sclerotial mycoparasite) to reduce their viability.

To be effective, biocontrol agents must be applied strategically to colonise the soil, or the root zone, quickly and at high levels. They should be applied so as to directly parasitise sclerotia in soil to reduce viability (incorporate into soil prior to planting) and/or to colonise in the plant's root region (apply into seedling mixes or seedling plugs prior to field transplanting) to protect from mycelium of sclerotia.

HAL project VG00048 focused on improving the formulation, shelf life and application of biocontrol agents (Table 1). Dry powder preparations of biocontrol agents can be incorporated into seedling mixes at sowing. Liquid preparations can also be applied to mixes and as a drench to the seedling transplants.

Trials showed commercial seedling mixes with a high percentage of composted pine bark were better substrates to incorporate *Trichoderma* species into because they had less naturally occurring non-pathogenic microbes, and therefore more space and food sources for *Trichoderma* biocontrol agents to grow.

***Tabel 1:** Biocontrol agents proven to be effective against sclerotia of Sclerotinia minor and/or suppressing infection in root zone of lettuce plants in overseas trials.*

Biological control agent (isolate)	Mode of action[A]
Coniothyrium minitans (Contans™)[B]	Specialised mycoparasite of sclerotia of *S. minor*
Coniothyrium minitans (A69)[C]	Good competition for nutrients and mycoparasite
Trichoderma hamatum (6Sr4)[C]	Good competition for nutrients and antibiosis

[A] As reported by manufacturers.
[B] Prophyta, Germany.
[C] Lincoln University and Agrimm Technologies Ltd, New Zealand.

Biocontrol agents can also be incorporated into soil, but this method is only effective if they are delivered into the region of soil where the roots grow. For example, a maize-perlite method of inoculum incorporation has delivered good levels of the biocontrol agents (*T. hamatum 6Sr4*) to the root region of lettuce plants.

An added effect of biocontrol agents, and some other microbes sold as soil conditioners, is they may promote better growth of seedlings. This has been observed on seedling roots in nurseries where there were high levels of biocontrol agent colonisation. For example, high levels of Trichoderma 6Sr4 and Trich-A-Soil™ promoted better lettuce seedling root growth, and high levels of *B. subtilis GB03* (Companion™) promoted better lettuce seedling growth.

Biological control agents must be registered with the Australian Pesticides and Veterinary Medicines Authority (APVMA) before they can be used specifically for the control of Sclerotinia diseases in Australia.

Note: Researchers are continually developing and testing new biocontrol products for use in horticultural crops as soil conditioners, growth promoters and for improved management of soil-borne diseases. For updates on new products contact your local pesticide supplier, agronomist or State Agricultural Department.

Biofumigants

Another promising non-chemical measure for Sclerotinia control is the use of inherent properties of some plants for 'disinfecting' soil or suppressing infection. For example, some Brassica crops (e.g. mustard) release volatile compounds (biofumigants) that are toxic to some soil pathogens.

Green manure Brassica crops that produce high plant biomass and high concentrations of biofumigant compounds offer advantages over low biomass manure crops and non-manure rotation crops for the control of soil-borne diseases.

A green manure crop is a crop grown in a crop rotation system for incorporation into soil to improve soil conditions, such as water infiltration and nutrients and organic matter levels. Information on different types of green manure crops (legumes, brassicas, grasses) suitable for rotations is available from Government agencies and agronomists.

Research in Tasmania showed BQ-Mulch™ (*Brassica napus*) and Fumus™ (*Brassica juncea*) crops, when used in rotation with lettuce, reduced Sclerotinia lettuce drop incidence by 89% and 46%, respectively. BQ-Mulch™ produces high levels of biofumigants (isothiocyanates or ITCs) in the roots and appears to be more effective in suppressing Sclerotinia lettuce drop infection than Fumus™ (mustard), which produced high levels of ITCs in its foliage.

Other organic soil amendments can produce similar volatile compounds when incorporated into soil. For example, 'mustard meal' and 'neem-cake' are two commercially available soil amendments with reported biofumigant properties.

Cultural and soil amendment strategies

Management practices such as crop rotations and soil amendments are becoming important tools for managing soil-borne diseases, including Sclerotinia. Rotations with crops less susceptible to Sclerotinia can prevent the build up of inoculum in soil.

Where possible, practice 3-4 year crop rotations to prevent the build up of Sclerotinia inoculum in soil. The use of Sclerotinia non-hosts, such as small grains and corn, and green manure crops can be useful in reducing the build up of inoculum and the incidence of Sclerotinia diseases in high disease sites.

Another example of the damage caused by Sclerotinia.

Incorporating a manure crop.

Some soil amendments with high content of nitrogen have shown potential to reduce inoculum carry over of some soil-borne pathogens.

Sclerotinia minor has a wide host range, which restricts the choice of a suitable rotation crop. In Tasmania, research showed that *S. minor* infection is closely correlated with plant architecture.

Adoption of these practices may be limited by cropping practices, availability of suitable rotation crops and soil amendments, and loss of income from not growing a commercial crop.

Summary and future research

Project VG00048 endeavoured to provide lettuce and other vegetable growers with information on the development of non-chemical control methods (biocontrol agents, biofumigant green manure crops), cultural and soil amendment strategies, and improved application of fungicide sprays for better management of Sclerotinia diseases in Australia.

The project found that control of Sclerotinia diseases can be improved by:

- using green manure Brassica crops in crop rotations
- selecting rotation crops more tolerant to Sclerotinia infection, especially in high Sclerotinia pressure sites
- the fungicide boscalid is a suitable replacement for procymidone

This project has identified new methods to produce, formulate and deliver biological control agents into cropping systems. The results thus far indicate some biocontrol agents have the potential to contribute to improved and sustainable disease control, only when integrated with other control measures. Thus, biocontrol agents should be considered an important component of an integrated control program for Sclerotinia diseases.

More information is required on the compatibility of biocontrol agents with farm practices (e.g. fertilisers, pesticides) and their survival in Australian soils growing vegetables under a variety of rotational cropping systems.

The use of crop rotations with Sclerotinia tolerant and non-host crops can prevent the build of inoculum in soils.

Soil amendment strategies such as the use of pre-planting applications of organic and nitrogenous soil amendment materials have the potential for making soil conditions suppressive to sclerotia and disease development. Soil amendment strategies investigated by this project require further development to optimise their use for Sclerotinia control. The effectiveness of other chemical and non-chemical treatments available for inoculum reduction should also be investigated.

Further Information

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