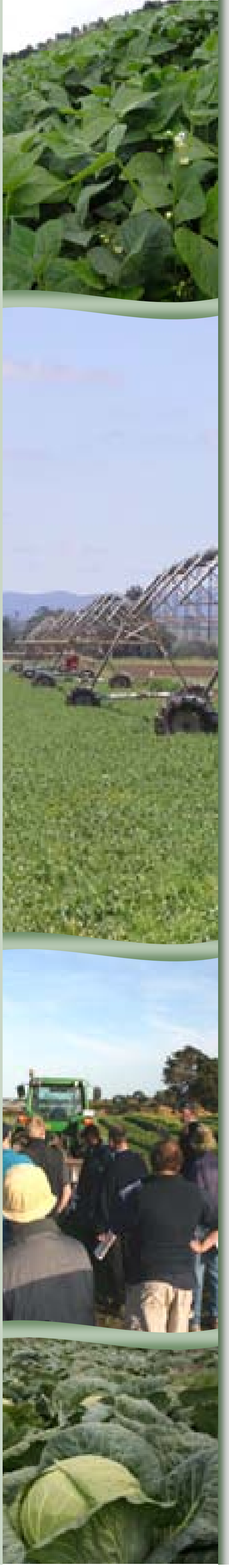


Managing Sclerotinia Diseases in Vegetables

Vegetable Disease Program IPM

New management strategies for lettuce drop and white mould of beans

KEY MESSAGES

- New management options developed to improve the control of Sclerotinia diseases.
- New fungicide treatments for lettuce drop and bean white mould and a plant-derived soil treatment to reduce disease carry-over.
- New biofumigant crops identified with high levels of anti-fungal compounds effective against Sclerotinia pathogens.
- Methods developed to predict the risk of white mould before sowing, during the growing season and before harvest.
- Information delivered to vegetable growers thorough demonstration sites, workshops and extension materials.
- Further research is needed to demonstrate the effectiveness of new strategies in different regions of Australia to maximise grower adoption.

Victoria The Place To Be

DEPARTMENT OF PRIMARY INDUSTRIES | biosciences research

For effective and durable Sclerotinia control it is better to integrate a number of methods including rotation, cultural practices, disease prediction and fungicides. For this reason, researchers at DPI Vic, Peracto Pty Ltd, TIAR/UTAS and Qld DEEDI worked together to investigate and develop multiple management options for Sclerotinia, using lettuce and green bean as model crops, in HAL project VG07216.

The long term aim of this research is to identify effective control measures and beneficial cultural practices for managing *Sclerotinia* which can be integrated into IPM and Best Management Practice (BMP) programs for sustainable production of vegetables in Australia.

About Sclerotinia

Sclerotinia causes significant yield and income loss to vegetable growers in all states of Australia, particularly in lettuce and green bean production. It is caused by two soilborne pathogens *S. minor and S. sclerotiorum.*

Major concerns for vegetable growers affected by Sclerotinia are:

- both pathogens have a broad host range and inoculum (sclerotia) survives in soil for many years.
- limited control options are available on the market, especially to reduce disease carry-over in soil.
- over reliance on one fungicide (Filan™) and lack of alternative fungicides that are effective under high disease pressure.
- lack of efficacious and cost-effective non-chemical control options and suitable cultural practices .

Management with Fungicides

Field trials in Victoria and Tasmania identified new fungicide treatments and application methods for control of bean white mould and lettuce drop.

Bean white mould (*S. sclerotiorum*).

The most effective treatments for white mould under moderate to high disease pressure were:

- Switch™ (cyprodinil + fludioxonil) and Filan™ (boscalid), applied during flowering, reduced disease by 81% and 83%, respectively, followed by Shirlan (fluazinam) by 58%.
- Folicur™ (tebuconazole) was effective only under low disease pressure (<10% disease incidence).
- Shirlan™ and Filan™, applied to the soil surface before row closure, reduced disease by 55% and 72%, respectively.
- Soil-applied Shirlan™ combined with Filan™, applied during flowering, reduced disease by 91%, demonstrating the potential of combining soil surface and foliar applications for more effective disease control.
- Du-Wett was the best of spray adjuvants tested, improving the performance of Filan™ when wetness periods were not protracted.

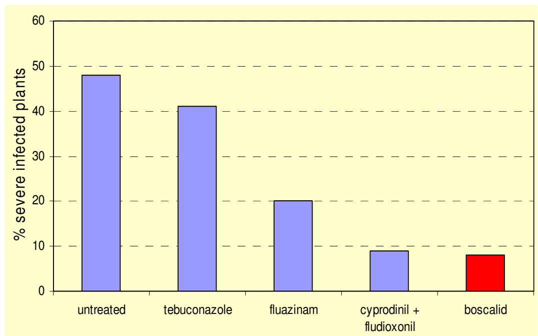


Figure 1. Control of white mould by fungicide treatments in Tasmania. Boscalid (Filan™) has a minor use permit until 31/1/13, see product labels for tebuconazole, other treatments currently do not have permits.

Lettuce drop (*S. minor*).

The most effective treatments for lettuce drop under low to moderate disease pressure were:

- Filan™, Switch™ and Shirlan™, applied as plant drenches, consistently reduced disease by 60-80%.
- Folicur™ gave poor or inconsistent control.
- The new fungicide AE C656948 (fluopyram) was shown to reduce *S. minor* infection by 80-86%.

Fungicide trial in lettuce crop in Tasmania.

Fungicide strategy.

Filan™ should not be overused to ensure it remains available to growers for a long time.
A strategy is proposed that incorporates the use of new fungicide treatments:

- Filan™, Switch™ and Shirlan™ all have actives with good soil residual activity which can provide good protection against *S. minor* mycelial infection and inhibition of *S. sclerotiorum* apothecia germination.
- Filan™ and Switch™ also have good activity against foliar infections caused by airborne ascospores of *S. sclerotiorum*.
- Switch™ and Shirlan™ therefore should be considered for registration or minor use permits in vegetables.
- Filan™ could be rotated with new and alternative fungicide treatments as required depending on disease pressure.
- Correct application of fungicide treatments is critical for good disease control.

Fungicide resistance.

A laboratory study found no evidence of resistance to boscalid (Filan™) in populations of *S. sclerotiorum* from bean fields in Tasmania, providing valuable baseline-sensitivity data to continue monitoring for boscalid resistance.

Managing Disease Carry-over

Evaluating soil treatments.

We are evaluating a wide range of chemical and non-chemical products to identify suitable soil treatments for inoculum reduction and disease control.

Plant-derived products.

Volatile compounds released from ECO-V, a blend of plant oils, have shown good biocidal activity at low doses (3-5% product) against sclerotia and mycelium of *S. minor*, *S. sclerotiorum* and inoculum of other soil-borne pathogens of vegetables. ECO-V, applied as a pre-plant soil treatment at 50 L/ha, also reduced the severity of bean root infections caused by Pythium and Rhizoctonia pathogens. Further field evaluation is required to optimise ECO-V for the management of soil-borne diseases.

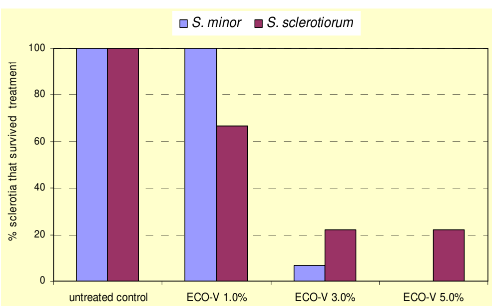


Figure 2. Efficacy of ECO-V against sclerotia of *S. sclerotiorum* and *S. minor* in soil bioassays.

Biocontrol agents.

Coniothyrium minitans (Contans™), a myco-parasite of *S. sclerotiorum*, sclerotia was evaluated in field trials in Tasmania, Victoria and Queensland for its ability to reduce populations of *S. sclerotiorum* and *S. minor* sclerotia in soil and protect lettuce and bean plants against infection.

- On lettuce, Contans™, first applied twice to lettuce residue and then as a drench to seedlings did not reduce lettuce drop incidence compared to Filan™ alone.
- On beans, Contans™, applied after sowing followed by three sprays of Filan™ slightly reduced white mould incidence and severity compared to applications of Filan™ alone.

Under high disease pressure, reliance on non-chemical controls alone such as biocontrols and plant products may not provide the control expected by growers. These treatments, however, have a place in an integrated control strategy, used in combination with fungicide applications.

Cultural Control Options

There are also many cultural methods that can be used to reduce inoculum levels of soilborne pathogens, such as:

- Rotation with non-host or less susceptible crops.
- Amending soil with residue of cover crops (green manuring).

Residue of some biofumigant (mustard species) and *brassica* crops (e.g. broccoli) can release volatile compounds that directly inhibit pathogens. Residue of green manure crops can also enhance soil microflora populations that compete with pathogens and improve soil health.

Crop rotation and biofumigant crops.

Our research has investigated the effect of rotation with green manure crops including new *brassica* biofumigant crops on soilborne diseases, yield and soil health. This is reported in another brochure.

Effect of ‘green manuring’ on inoculum survival.

The effect of this practice on survival of *S. minor* sclerotia is being thoroughly studied to identify combinations of green manure crops and soil characteristics that result in soil conditions detrimental to the survival of sclerotial inoculum.

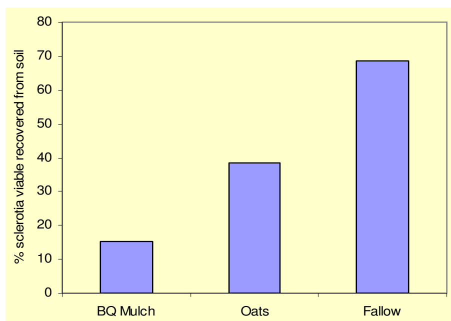


Figure 3. In field effect of amending soil with residue of two green manure crops on survival of sclerotia of *S. minor*.

The efficacy of ‘green manuring’ on pathogen mortality depends on many factors including soil characteristics, plant tissue composition, length of soil treatment and biological (e.g. anaerobic capacity) and chemical (e.g. organic acids, volatile compounds, pH) changes in soil. This process has to be understood to develop this for industry.

Some of the key outcomes from pot and field trials showed:

- In pot trials, oats and BQ Mulch residue added to moist soil at 5% w/w reduced *S. minor* sclerotia survival by 92% and 65% in sandy soil and by 94% and 50% in silty soil, respectively.
- Molasses (2% w/w) reduced sclerotia by 95% in both soils, attributed to enhanced microbial activity which increased the breakdown of organic matter and sclerotia.
- Reducing oxygen in soil tended to increase sclerotia mortality only in sandy soil amended with BQ Mulch, suggesting 'anaerobic conditions' in this soil were detrimental to sclerotia.
- In the field, residue of BQ Mulch was more effective than oats in reducing the populations of *S. minor* sclerotia in the sandy soil.

Other cultural options.

There are other cropping practices that can be used if economical to reduce the severity of infections caused by Sclerotinia pathogens, including:

- increasing plant spacing to reduce canopy conditions (moisture levels) favourable for disease development.
- using bean varieties which have less dense canopies and lettuce cultivars with more upright growth habits.
- good sanitation, weed control and irrigation practices to prevent inoculum and disease spread.

Bean cultivar susceptibility.

The effect of canopy characteristics of four processing (Celtic, Stanley, Flavor Sweet, Montano) and one fresh market (Valentino) green bean cultivars on white mould development was investigated in Tasmania.

- Valentino, a tall variety with large leaves and slightly longer flowering period, was the most susceptible variety.
- there were no differences in susceptibility among the other four varieties.
- reducing seedling density (Flavor Sweet) by 30% did not affect white mould development because plant canopy grew larger to cover the available plant space.

Field trial in a bean field in Tasmania.

Methods to Predict Risk of White Mould

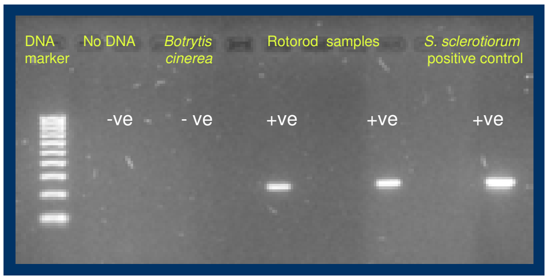
In bean crops more than 10% white mould incidence may result in whole crop rejection by processors causing significant economic loss to growers. This research has used different approaches to tackle this problem by developing decision-support tools to help growers improve the management of white mould at the site and crop level. Survey and epidemiological studies conducted in bean fields in Tasmania provided data to develop three methods to identify white mould risk before planting, during the crop's life and pre-harvest.

1. Predicting site-specific risk.

By knowing the key factors that drive disease development, bean growers can identify fields prior to planting which are likely to be at high risk of white mould disease and modify agronomic practices accordingly.

2. Predicting risk of infection.

A molecular-based technique (PCR) was developed to detect airborne ascospores of *S. sclerotiorum*. The technique used in conjunction with spore traps and weather data can be used to identify periods of 'high risk of infection' so that growers can improve the timing of fungicide applications and improve disease control.



PCR test for *S. sclerotiorum*

3. Determining disease levels before harvest.

Development of samplings protocols to allow more rapid measurement of disease incidence in the field to help with decision-making.

The three predictive methods require commercial validation to fully develop these decision-support tools for improving the management of white mould.

Benefits to vegetable industry

- New strategies developed to improve the control of key Sclerotinia diseases of vegetables.
- Efficacy data provided to AgAware for development of minor use permits or registration.
- Once implemented, new strategies will reduce crop losses and increase grower's profit margins and farm productivity.
- New strategies and economic benefits have been discussed with growers during field trials, workshops, articles and brochures to fast track adoption.
- The next step is to demonstrate the new strategies in different regions of Australia to maximise industry adoption.

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