
Integrated management of *Sclerotinia* disease in beans

FINAL REPORT

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***Sclerotinia* disease on green beans**



Photo 1: *Sclerotinia* infected plants in a trial plot at Merseylea



Photo 2: *Sclerotinia* disease severity ratings used in disease assessments.

Table of Contents

INDUSTRY SUMMARY	1
TECHNICAL SUMMARY	2
RECOMMENDATIONS	4
INTRODUCTION	5
PRODUCT FORMULATIONS	6
SECTION 1: LITERATURE REVIEW	8
SECTION 2: GROWER SURVEY AND FIELD INSPECTIONS	10
2.1: GROWER SURVEY	10
2.2: FIELD INSPECTIONS	21
SECTION 3: FUNGICIDE RESISTANCE.....	24
SECTION 4: FUNGICIDE APPLICATION METHODS.....	28
4.1 SPRAY COVERAGE	30
4.2: FIELD TRIALS CONDUCTED IN 1998/99	35
4.3: THE EFFECTS OF WATER VOLUME ON SUMISCLEX EFFICACY	45
4.4: THE EFFECTS OF SPRAY ADJUVANTS ON THE SYSTEMIC ACTIVITY OF FUNGICIDES	47
SECTION 5: ALTERNATIVE PRODUCTS.....	51
SUMMARY	51
INTRODUCTION	51
5.1: FIELD TRIAL CONDUCTED IN 1997/98	52
5.2: FIELD TRIALS CONDUCTED IN 1998/99	55
SECTION 6: REFINING FUNGICIDE APPLICATION METHODS AND EFFICACY OF ALTERNATIVE PRODUCTS	64
SUMMARY	64
INTRODUCTION	65
6.1: FIELD TRIALS CONDUCTED IN 1999/2000	66
TECHNOLOGY TRANSFER.....	78
REFERENCES	79
ACKNOWLEDGMENTS.....	80
APPENDICES.....	81
GROWER SURVEY FORM	APPENDIX I
CRITICAL CONCENTRATIONS OF SPIN FLO AND SWITCH FOR EC50 TESTING	APPENDIX II
AVCARE FUNGICIDE GROUPING	APPENDIX III

Industry Summary

White mould, caused by *Sclerotinia sclerotiorum*, is a major disease problem of both green and navy beans, causing yield losses by premature plant death through lower stem infection, and/or infection of beans. Green bean crops with greater than 8% *Sclerotinia* are rejected due to difficulties in processing. This 3-year HRDC funded project aimed to identify the cause of poor *Sclerotinia* control in the field, to review new developments in *Sclerotinia* control on other crops, to identify alternative control products, and to improve methods for *Sclerotinia* control.

Fungicide application methods and timing

A survey of bean growers showed that application methods are highly variable between growers, and that, along with different weather conditions, location and cultural practices, can influence the level of *Sclerotinia* control.

Field studies showed that the timing of the first spray application of Sumisclex or Fortress (procymidone) is the most important factor in determining the level of *Sclerotinia* control. Application methods such as spray nozzle types, droplet size, and water volume, were shown to have less influence.

Fungal resistance to fungicide

None of the 37 isolates of *Sclerotinia sclerotiorum* collected from different areas of Queensland and Tasmania and screened for sensitivity to the fungicides Benlate, Sumisclex, Switch and Spin Flo, were found to be resistant to any of the fungicides.

Alternative products

In field trials conducted over three seasons, Sumisclex or Fortress, applied at the rate of 1.5L/ha, often resulted in the most effective disease control.

Among the alternative fungicide and biological products evaluated in field trials, two new products, Switch and Spin Flo (also sold as Bavistin), were identified as having potential for *Sclerotinia* control. Spin Flo gave better disease control than Benlate or Switch, and may be a suitable alternative to Benlate, for use in alternation with procymidone. A field trial conducted in Queensland from March to May 2000, showed that Spin Flo performed as well as procymidone. Note that at the time of the publication of this report, Spin Flo is still not registered for use in bean crops.

Extension of results

Project findings were presented through newsletters, field days, Tasmanian vegetable extension days and conferences, throughout the life of the project, and at the QFVG Growing for Profit Day, 15th November 2000, at Gympie, Queensland.

Technical Summary

White mould, caused by *Sclerotinia sclerotiorum*, is a major disease problem of both green and navy beans, causing yield losses by premature plant death through lower stem infection, and/or infection of beans. Green bean crops with greater than 8% *Sclerotinia* are rejected due to difficulties in processing. This 3-year HRDC funded project aimed to identify the cause of poor *Sclerotinia* control in the field, to review new developments in *Sclerotinia* control on other crops, to identify alternative control products, and to improve methods for *Sclerotinia* control.

Literature review/field inspections

Control of white mould on beans caused by *S. sclerotiorum* requires an integrated approach in crop management. The disease management strategy is based on knowledge of the fungal disease cycle, effectiveness of fungicides, application methods, and the importance of field hygiene and crop rotations. The use of cultural practices such as reduced plant density, row spacing and orientation, and irrigation to reduce microclimatic conditions that favour the disease, has been researched and recommended. A literature review was conducted to cover research studies in these areas, with particular emphasis on knowledge that may assist in improving current disease control practices and future requirements.

Field observations indicated that the most important factors that influence the level of *Sclerotinia* disease are location, paddock terrain, weather, variety, plant litter on the ground, mechanical damage and poor water drainage. These factors need to be taken into consideration in deciding plant density, row spacing, and the timing and number of fungicide sprays to be used.

Fungal resistance to fungicides

None of the 37 isolates of *Sclerotinia sclerotiorum* and one isolate of *Sclerotinia minor*, collected from different areas of Queensland and Tasmania and screened for sensitivity to the fungicides benomyl (Benlate), procymidone (Sumisclex or Fortress), cyprodinil + fludioxonil (Switch), and carbendazim (Spin Flo), were found to be resistant to any of the fungicides.

Fungicide application methods

A survey of bean growers showed that application methods are highly variable, and along with different weather conditions, location and cultural practices, can influence the level of *Sclerotinia* control.

Field studies showed that the timing of the first spray application of procymidone is the most important factor in determining the level of *Sclerotinia* control. Application methods such as spray nozzle types, droplet size, and water volume, were shown to have less influence.

Fungicides / alternative products

In field trials conducted over three seasons, procymidone at the rate of 1.5L/ha often gave the greatest disease reduction compared to other products evaluated. Two new products, Switch and Spin Flo, were also identified as having potential for *Sclerotinia* control. Spin Flo gave better disease control than Benlate or Switch, and may be a suitable alternative to Benlate, for use in alternation with Sumisclex. A field trial conducted in Queensland in early 2000, showed that Spin Flo performed as well as Sumisclex. Note that at the time of the publication of this report, Spin Flo is not registered for use in bean crops. The economic feasibility of registering Spin Flo is being evaluated by Aventis CropScience Pty Ltd (formerly Rhone-Poulenc Rural Australia Pty Ltd).

Technical Summary (Cont.)

Although Switch significantly reduced disease incidence and severity when compared to the untreated control, the level of control was much lower than with the currently registered products Sumisclex and Benlate. As a result, Novartis Crop Protection Pty Ltd has indicated that the company would not be interested in further studies, or in registering this product for *Sclerotinia* control in beans.

ABG8001 and ABG8013, biocontrol products based on *Trichoderma harzianum* produced in Israel, were also evaluated in this project. ABG8001 is a registered biocontrol agent for disease control and is sold commercially. Unfortunately, samples of the product supplied for field testing over a two-year period had low viability. Therefore, the resulting poor efficacy in *Sclerotinia* disease control may not be representative of the product's potential if the required biocontrol population is attainable.

Laboratory tests showed that *Trichoderma* was tolerant to Sumisclex. The application of ABG8001 with Sumisclex appeared to cause a slight reduction in *Sclerotinia* incidence and severity compared to Sumisclex alone. Little or no disease control was recorded when ABG8001 was applied alone. This raised the possibility of enhancing the performance of the biocontrol agent when applied with a suitable fungicide.

The biocontrol product PRP01, which is based on *Coniothyrium minitans*, is a fungal parasite of *S. sclerotiorum* that is sold in Europe as pre-plant product application for *Sclerotinia* disease control. In a field trial evaluation, this biocontrol agent did not reduce disease incidence when applied alone. This could be due to infections from airborne ascospores produced in adjacent untreated areas. Unlike ABG8001, PRP01 was found to have a good viability and shelf life.

There was, however, a significant interaction between pre-plant PRP01 soil applications and post-plant Fortress foliar sprays. The soil treatment with PRP01, followed by Fortress spray applications with 500L/ha water, gave better disease control than Fortress spray applications alone. This indicates that this biocontrol product has the potential of improving *Sclerotinia* control if used in conjunction with a regular fungicide spray program.

It is recommended that biocontrol agents be evaluated in long-term studies to properly determine their potential for *Sclerotinia* disease control, especially for reducing the level of sclerotia in soil.

Recommendations

- When using a boom sprayer, spray water volumes ranging from about 150 to 400L/ha appear to be adequate, when applied at the early flowering period.
- Early fungicide applications, at 5 to 10% plants with first flowers and before canopy becomes dense, give optimum disease control.
- The recommendations on the labels of Benlate and Sumisclex, to spray when 75% plants first show open flowers, need to be reviewed.
- In areas prone to severe *Sclerotinia* disease, cultural practices, such as low planting density, wider row spacing, and bean varieties, that can assist in reducing conditions conducive to disease development, should be considered.
- In areas that are not prone to severe *Sclerotinia* infections, an increase in planting density in conjunction with the use of appropriate fungicide and spray methods, could significantly increase yield per hectare.
- Fungicides based on procymidone, Sumisclex and Fortress, are still the most effective products for control of *Sclerotinia* in bean crops.
- Carbendazim (Spin Flo and Bavistin) appears to give better disease control than benomyl (Benlate), and may be a suitable alternative to benomyl for use in alternation with procymidone.
- Biocontrol agents need to be evaluated in long-term studies to properly determine their potential for *Sclerotinia* disease control, especially for reducing the level of sclerotia in soil.

Target Disease

Sclerotinia rot or white mould disease caused by *Sclerotinia sclerotiorum*.

Background

White mould, caused by *Sclerotinia sclerotiorum*, is a major disease problem of both green and navy beans. It can cause yield losses by premature plant death through lower stem infection, and/or infection of beans. Green bean crops with greater than 8% *Sclerotinia* are rejected due to difficulties in processing.

High yields are essential to enable the Australian processing bean industry to be competitive against imported products. Unfortunately, increasing yield per hectare is often hampered by an increase in *Sclerotinia*. Conditions that promote crop growth and yield also promote *Sclerotinia* disease severity. As a result of this interaction, many crops are intentionally grown under less than ideal conditions for maximum yield, limiting growth in order to reduce disease severity. This means that many bean crops are losing up to 50% of potential yield. The potential of narrow row spacing to double yield is also hampered by unreliable control of *Sclerotinia*.

Benomyl (Benlate) and procymidone (Sumisclex or Fortress) are the only two fungicide products currently registered for use against *Sclerotinia* disease on beans. There have been concerns that the regular use of these control products may result in *Sclerotinia* resistance to the fungicides. The withdrawal of one registered product would further limit the choice of available fungicides for the control of *Sclerotinia*. Hence, many growers consider the evaluation and development of new products for *Sclerotinia* control to be essential.

In recent years, field officers and growers have noted poor control of *Sclerotinia* on beans. It is not clear whether this relates to the fungicides used, spray methods, crop density, spray timing or other factors. This is of great concern to growers, in view of the high cost of chemical control programs.

This project, therefore, aimed to identify the cause of poor *Sclerotinia* control in the field, to review new developments in *Sclerotinia* control on other crops, to identify alternative control products, and to improve methods for *Sclerotinia* control.

Bean plants tend to be most susceptible to white mould disease close to maturity, when crops become very dense. Flowers are produced from about six weeks after sowing until harvest, and most of them are located beneath the plant canopy. High humidity, prolonged plant wetness, and flowering beneath the crop canopy create an ideal environment for disease infection. Unfortunately, with canopy closure, spray penetration of fungicide sprays can be very poor. Under such conditions, a competitive non-pathogenic fungus such as *Trichoderma* may prevent late *Sclerotinia* disease development. *Trichoderma* based biocontrol products for disease control are now available commercially and are to be evaluated in this project.

Product Formulations

Fungicides

Product	Active ingredient (a.i.)	Rate of a.i.	Formulation	Chemical Group
Amistar	azoxystrobin	500g/kg	Wettable granules	Strobilurin
Benlate	benomyl	500g/kg	Wettable powder	Benzimidazole
Bravo	chlorothalonil	720g/L	Suspension concentrate	Multi-site activity
SS01	chitosan	4%	Suspension liquid	Unspecified
Folicur	tebuconazole	430g/L	Suspension concentrate	DMI
Fortress	procymidone	500g/L	Suspension concentrate	Dicarboximide
Rovral	iprodione	250ml/L	Suspension liquid	Dicarboximide
Saprol	triforine	200g/L	Suspension liquid	DMI
Spin Flo	carbendazim	500g/L	Suspension concentrate	Benzimidazole
Sumiscllex	procymidone	500g/L	Suspension concentrate	Dicarboximide
Switch	cyprodinil + fludioxonil	375g/kg + 250g/kg	Wettable powder	Anilinopyrimidine

* The chemical group, used for resistance management, was developed by Avcare (Appendix iii).

Biocontrol products

Product	Active ingredient (a.i.)	Rate of a.i.	Formulation
ABG8001	Trichoderma harzianum	10 ⁸ colony forming units/g	Wettable powder
ABG8013	Trichoderma harzianum	10 ⁸ colony forming units/g	Wettable powder
PRP01	Coniothyrium minitans	10 ⁸ colony forming units/g	Soluble granules

Product Formulations (Cont.)

Spray Adjuvants

Product	Active ingredient (a.i.)	Rate of a.i.
Agral	Nonyl ethylene oxide	600g/L
Agridex	Paraffin based petroleum oil + polyol fatty acid esters	714g/L + 155g/L
Bond	Synthetic latex + nonylphenoethoxylate	450g/L + 100g/L
DCTron Plus Spray Oil	Petroleum oil	839g/L
NuFilm	Di-1-p menthene	96%
SprayTech Codacide Oil	Organic vegetable oil	N/a
X-77	Nonyl ethylene oxide	370g/L