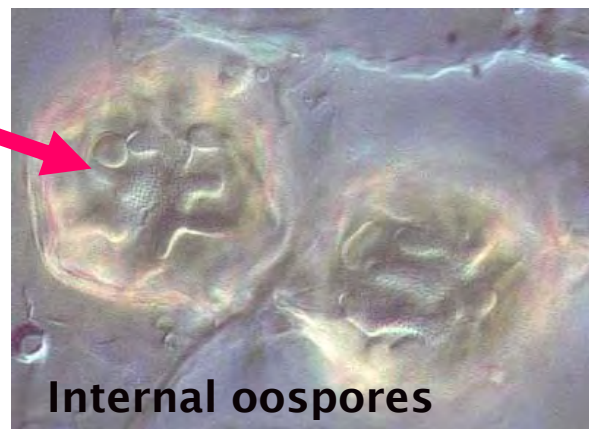
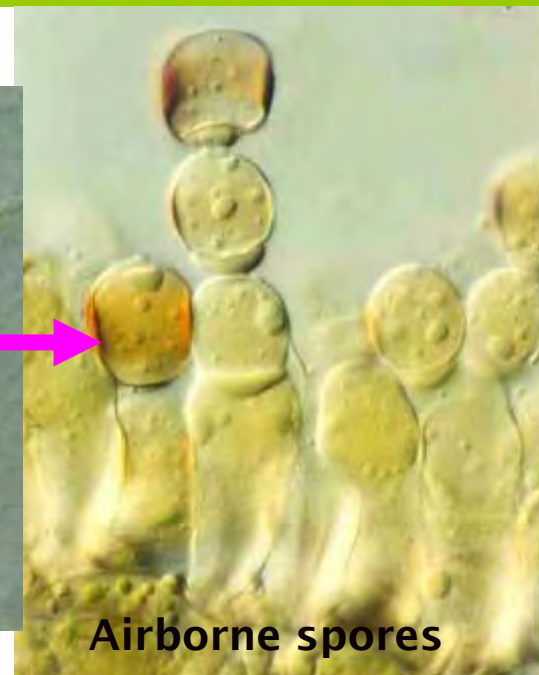
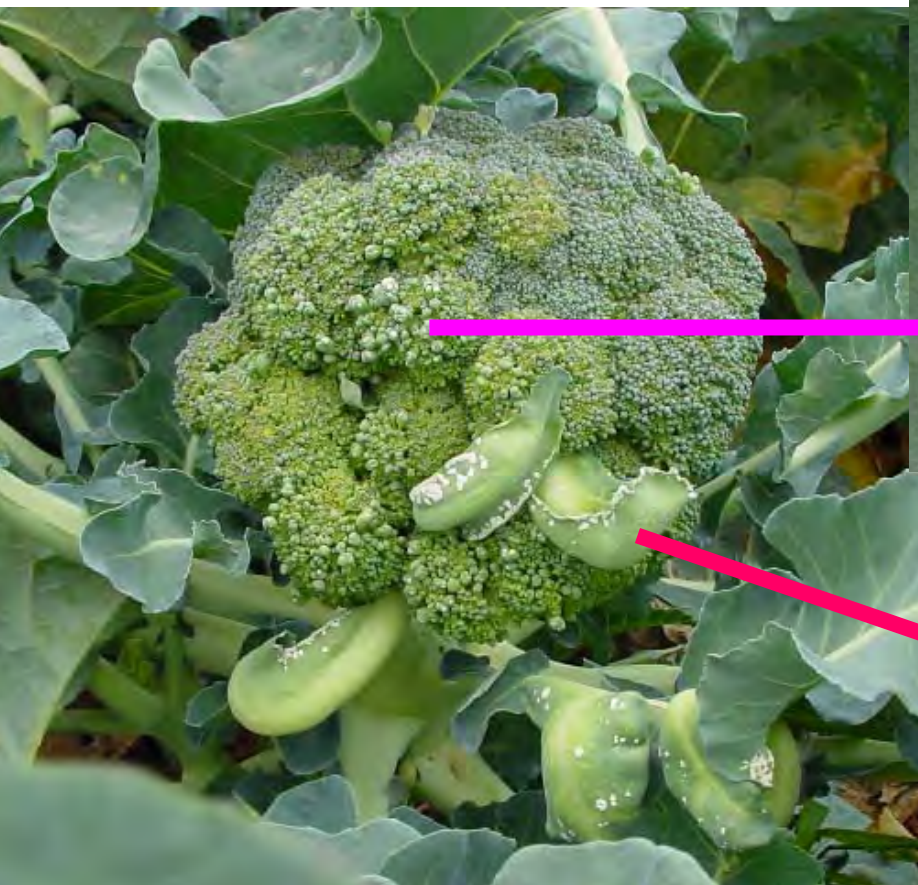


# White Blister



## Project team:

Dr Elizabeth Minchinton - project leader

Joanna Petkowski, Dr Robert Faggian, Dr Fiona Thomson, Des Auer

# Races of White Blister

Race (Ac)	Host scientific name	Host common name
1	<i>Raphanus sativus</i>	Radish
2	<i>Brassica juncea</i>	Indian mustard
3	<i>A Armoracia rusticana</i>	Horseradish
4	<i>Capsella bursa-pastoris</i>	Shepherd's purse
5	<i>Sisymbrium officinale</i>	Hedge/tumble mustard
6	<i>Rorippa islandica</i>	Marsh/yellow watercress
7	<i>B.rapa (campestris, pekinensis, chinensis)</i>	Field mustard, Chinese mustard, Chinese Cabbage, pak-choi
8	<i>B.nigra</i>	Black mustard
9	<i>B.oleracea</i>	Broccoli, Brussels sprouts, Cauliflower, Kale, Kohlrabi, Cabbage
10	<i>B.kaber (Sinapis arvensis)</i>	Charlock

• Not on cabbage in Australia

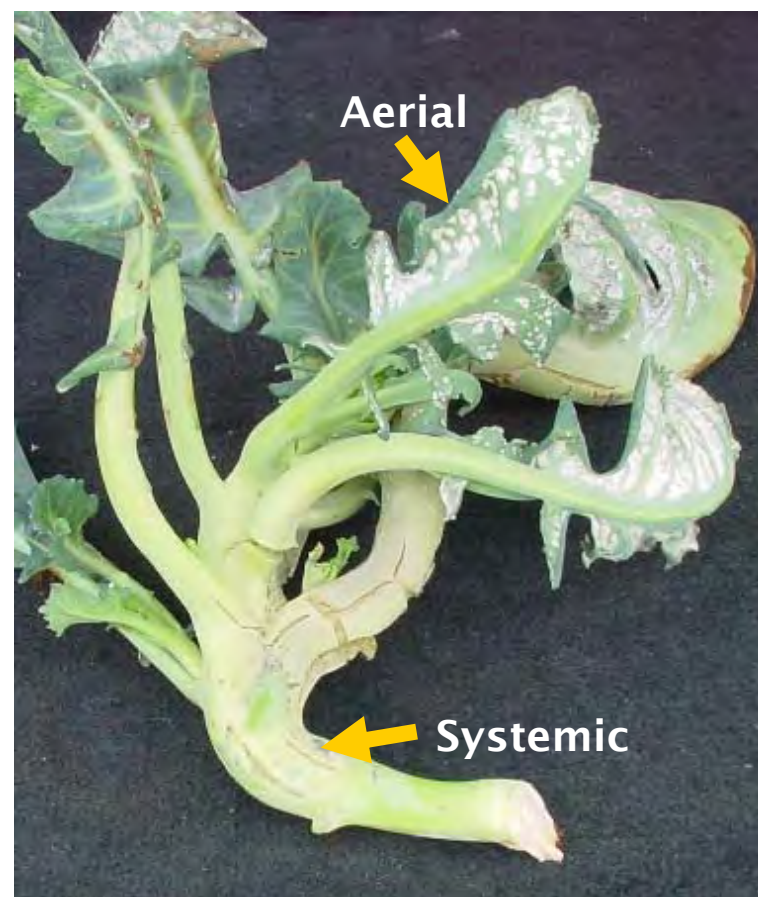
## White blister on cabbage in the UK



Photo courtesy of Caroline Donald

# Spread of White Blister on Broccoli & Cauliflower in Australia & New Zealand

State	Time of Report
VIC	January 2002 (1 <sup>st</sup> report 1980)
TAS	December 2002
NSW	May 2003 (1 <sup>st</sup> report 1990)
SA	May 2003
WA	June 2003
NZ	February 2005
QLD	August 2005



Systemic and aerial phase of white blister

# White blister in New Zealand

Richard Falloon & Mark Braithwaite



- 1st report 1906
- Variety of hosts - cabbage
- Surveyed crops
- Collaborative brochure
- NZ project on race ID  
- Dr Eric McKenzie

# Results of Survey

Site	Cultivar	Incidence	Area
Original	Viper	<1%	Lincoln
1*	Viper	2-5%	Southbridge
2	Maverick	<1%	Southbridge
3	Various	<1%	Lincoln
4	Legacy	0	Marshlands
5	Belstar	0	Marshlands
6	Decathlon	80%	Marshlands
7	Maverick	0	Marshlands
8	Belstar	0	Marshlands
9	Legacy	0	Marshlands
10	Legacy	0	Marshlands

\* Grower observed white blister in 2004

# White Blister Project

- **Differentiate *A. candida* races (molecular & classical)**
  - ID of Vic. race on broccoli
  - Sources (other hosts, seed)
  - Development of a molecular seed health test
- **Identification of management strategies**
  - Evaluate the Brassica<sup>spot</sup> disease predictive model (collaboration Dr Roy Kennedy HRI UK)
  - Chemicals - systemic, contact & soft
  - Irrigation timing
  - Cultivar trials

# Which race is responsible for the Vic outbreak?

- **Broccoli (spores) → 12 hosts**
    - 80% broccoli & cauliflower
    - 75% black mustard
    - 0% cabbage
- = Race 9 (?)**





## Source - Other Hosts

### Cross - inoculations

- Pak choy spores (Race 7) → broccoli etc ✗  
→ Pak Choy ✓
- Shepherd's purse spores (Race 4) → broccoli etc ✗  
→ Shepherd's Purse ✓

**= Not from common alternate hosts**



## Source - Seed Health

- Oospores on the seed coat
- Found on radish, canola & mustards OS



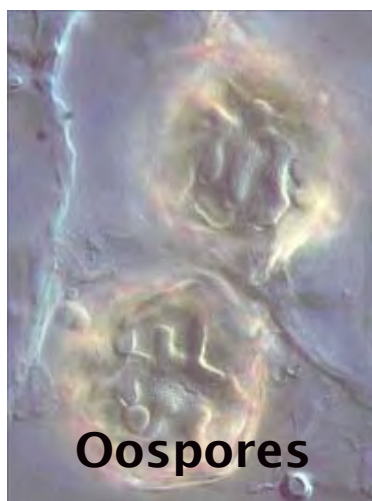
Oospores



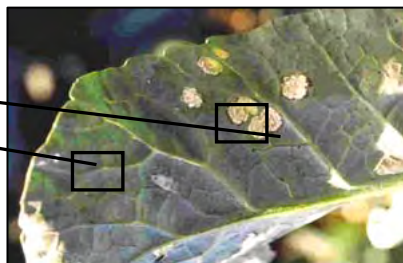
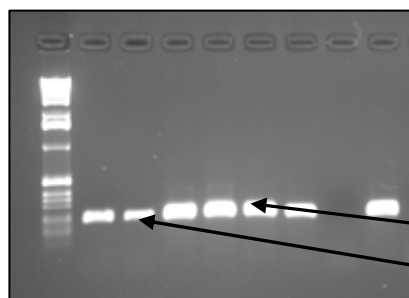
White blister on a seed  
pod

- Seed wash for oospores:
  - +ve on *B. nigra* (black mustard)
  - ve on *B. oleracea* & *B. rapa*
- Oospores on seed not a regular source of infection

# Race Differentiation: - Molecular tools



- Molecular test to ID White Blister(PCR)
- Does not separate races
- Detect one oospore
- Quick & cheap → seed health test
- Currently screening of important genes



PCR

# Efficacy of chemicals to control white blister

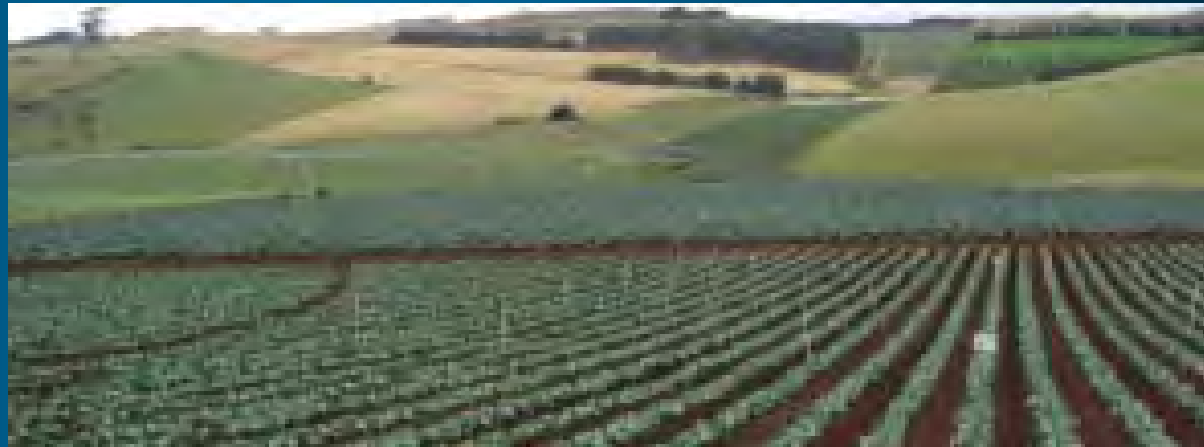
Trade name	Active ingredient
Acrobat®	dimethomorph
Agri-Fos® 600	phosphonic acid
Amistar®	azoxystrobin
Barrack®	chlorothalonil
Baycor 300EC®	bitertanol
Vibrex™	chlorine dioxide
Dithane DF®	mancozeb
Dithane DF®	mancozeb with acrobat
Euparen®	dichlofuranid
F51601f	boscalid & pyraclostrobin
Fruvit®	propioneb & oxadixyl
Kocide®	copper oxychloride
Li700™	soyal phospholipids & propionic acid
Plantvax®	oxycarboxin
Ridomil Gold MZ®	mancozeb & metalaxyl
Thiovit®	sulphur
SDS	sodium dodecyl sulphate
Zineb®	zineb

- glasshouse seedling trial
- on farm nursery trial
- transplant and head field trials
- model evaluation trials
- Chemical treatments suitable for various growth stages
  - systemic fungicides (long withholding periods)
  - contact fungicides
  - soft chemicals (ionic and non-ionic surfactants)

# Forth, Tasmania 2004

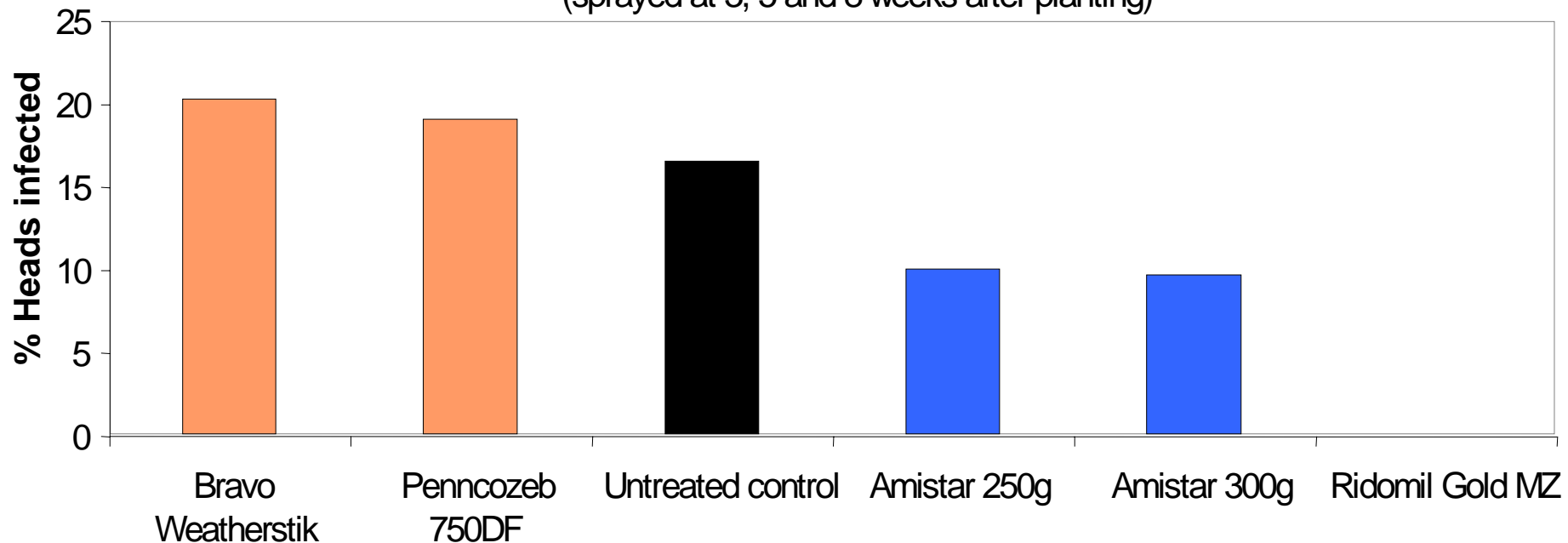
Fungicides for  
white blister  
management

Dr. Hoong Pung,  
Serve-Ag Research



## Forth trial on fungicide efficacy (3 sprays, Feb to Apr 04)

(sprayed at 3, 5 and 8 weeks after planting)



# Evaluation of the disease risk prediction model

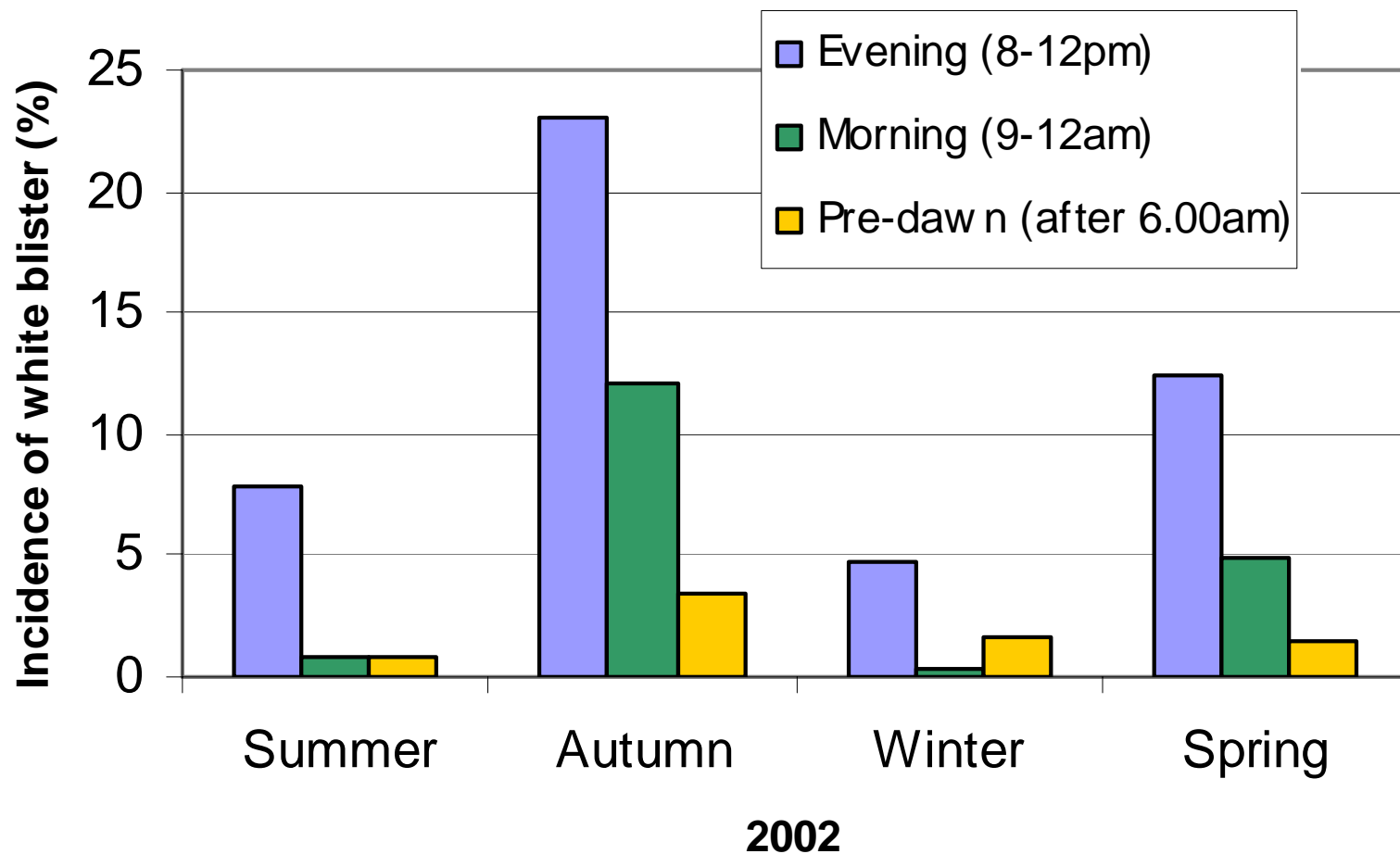
- ‘Infection’ model (temperature & duration of leaf-wetness)
- ‘Sporulation’ model under development in the UK
- Disease controlled with reduced number of fungicide application v/s calender sprays
- Crop monitoring indications



# Conditions for white blister infection

- airborne spores (white powder) available at all times
- temperature from 6 - 24°C
- at least 4 hours of leaf wetness
- symptoms in 7 - 21 days after the infection
- timing of irrigation to reduce the duration of leaf wetness
- a few disease cycles during the crop life
- *A. candida* life cycle

## Effect of Irrigation on Incidence of White Blister on radish





# Model evaluation trials in Dandenong South and Werribee South

- **weekly spray programs vs sprays according model predictions and crop monitoring**
- **disease incidence and severity assessed weekly or according model indications**

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## Werribee South Broccoli cv. Legacy

Control (non-sprayed)

Agri-Fos®600 + DithaneDF® weekly

Ridomil GoldMZ®/TribaseCopper 4x/weekly

CropLife™ weekly

Cabrio® transplant/monitor

Model/Ridomil GoldMZ® model/monitor

Model/Cabrio® model/monitor

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## Dandenong South Broccoli cv. Marathon

Control (non-sprayed)

Agri-Fos®600 + DithaneDF® weekly

Ridomil GoldMZ®/TribaseCopper 4x/weekly

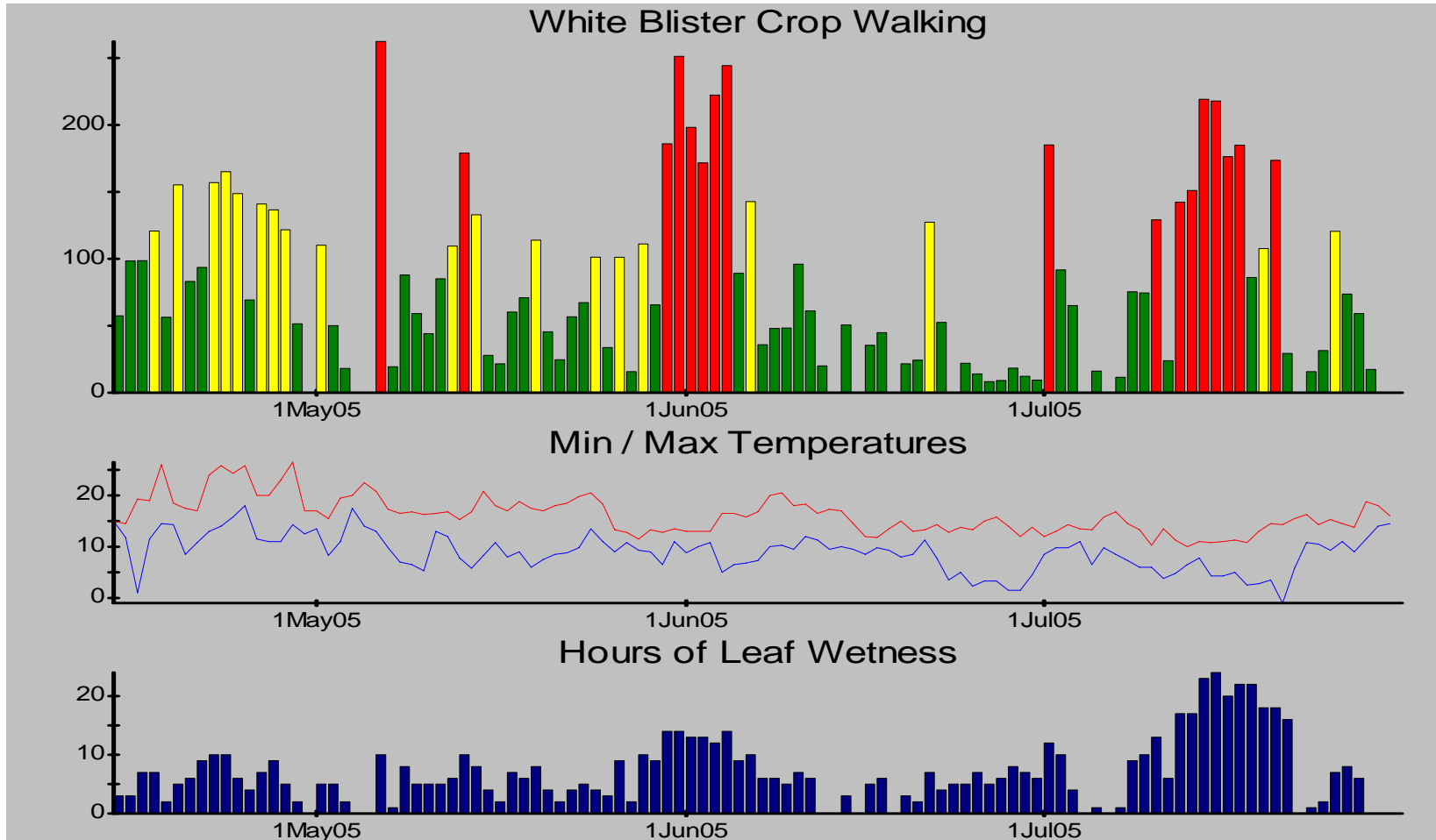
Cabrio® transplant/monitor

Model/Ridomil GoldMZ® model/monitor

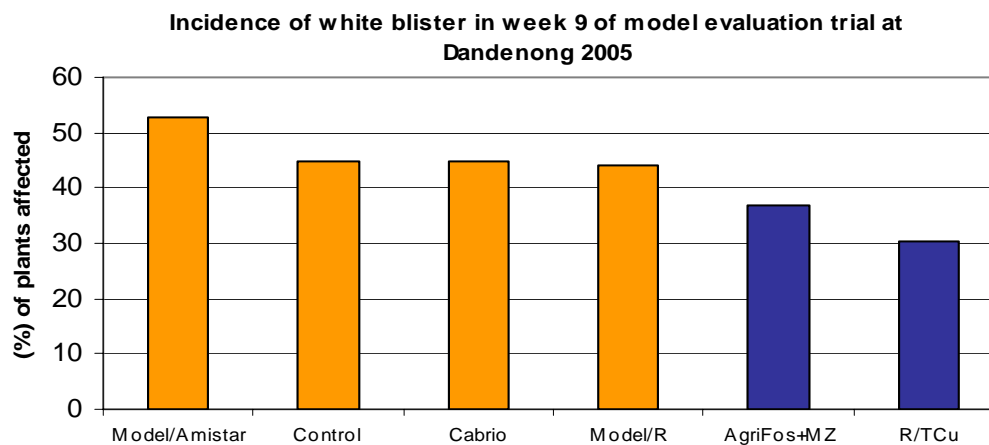
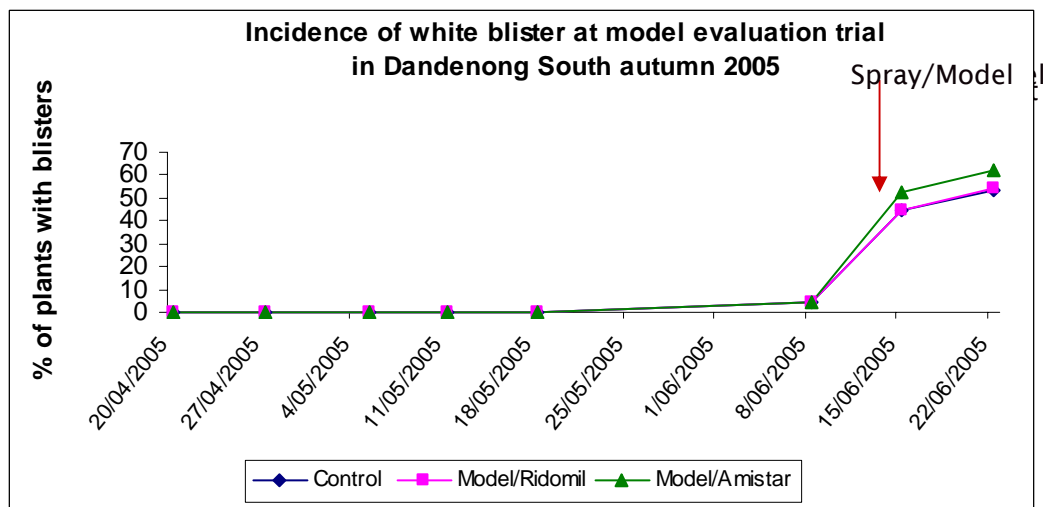
Model/Cabrio® model/monitor

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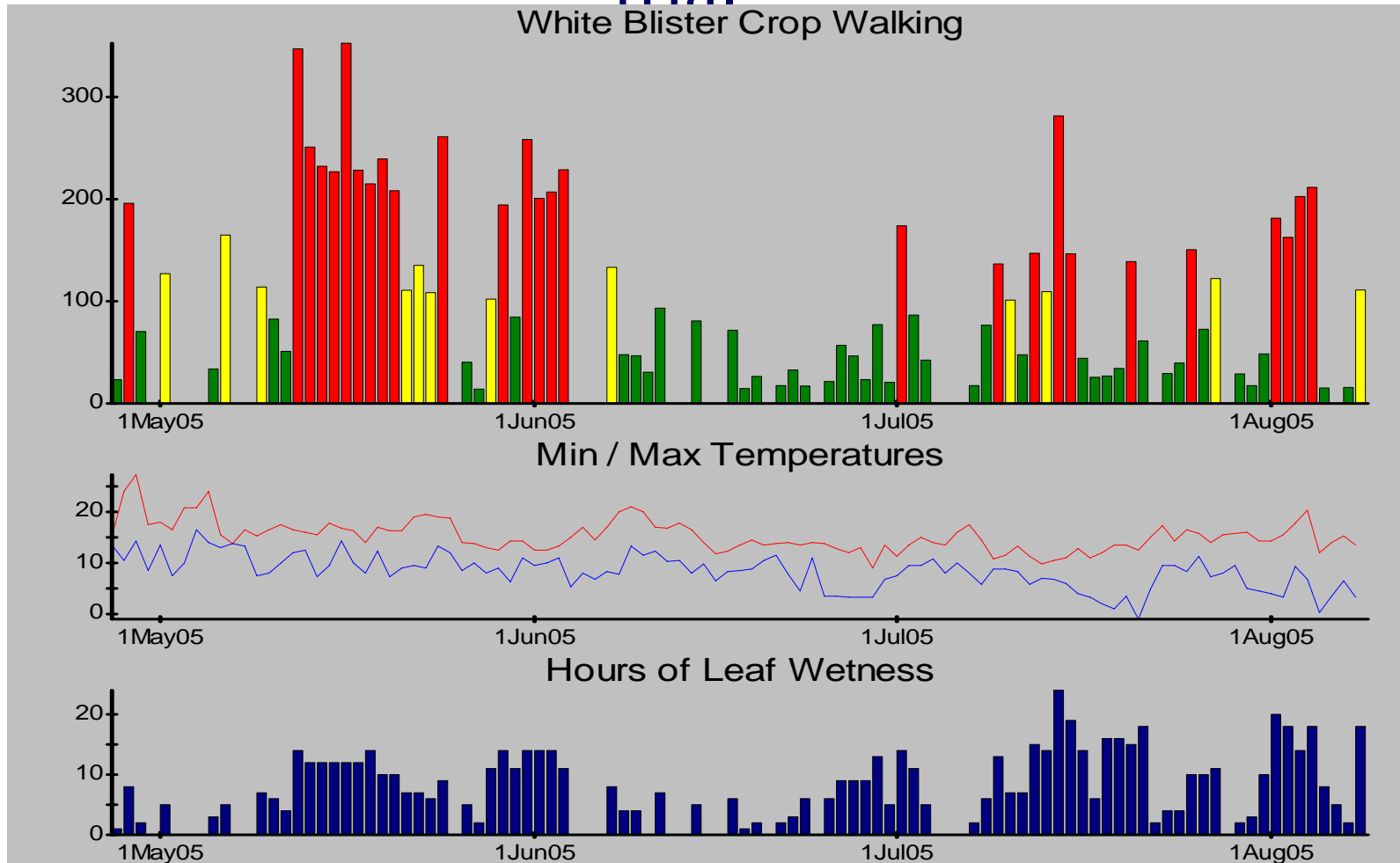
# Brassica<sup>Spot</sup> risk prediction for Dandenong South trial



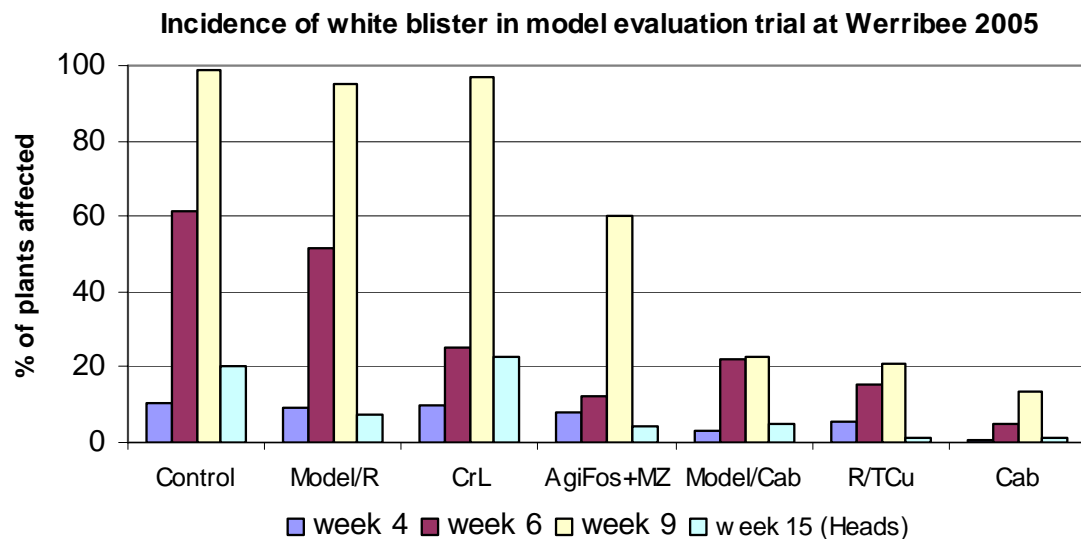
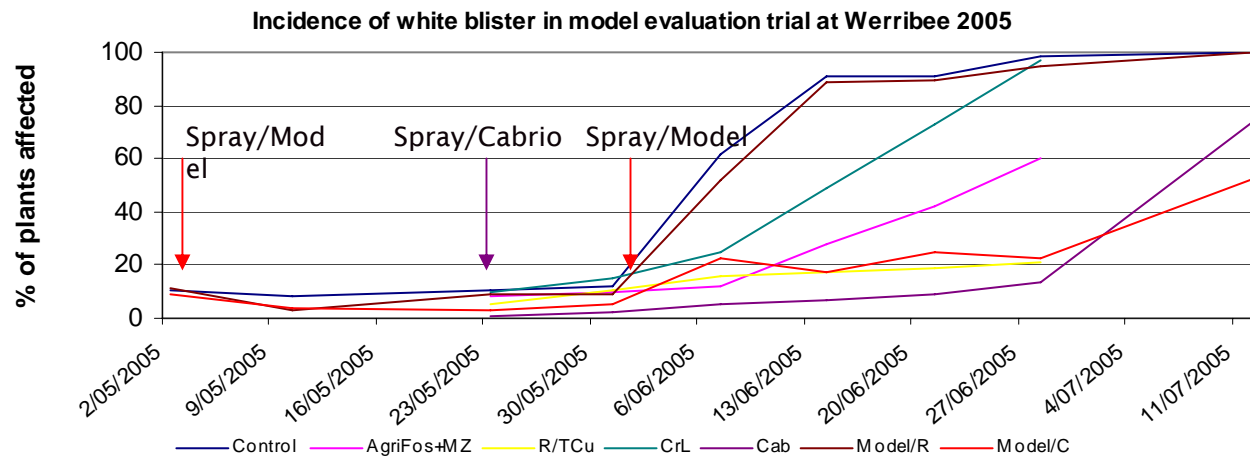
# Dandenong South trial results



# Brassica<sup>Spot</sup> risk prediction for Werribee South trial



# Werribee South trial results



## Summary

- **White blister appeared/reinfected crops according to model predictions in both trials**
- **No fungicide sprays required for disease control at Dandenong South site**
- **White blister kept in check by 2 applications of Cabrio (calender/model) and weekly application of TriCu at Werribee trial**
- **Brassica<sup>Spot</sup> is an effective decision support tool for disease control in Victorian broccoli crops**

## Fungicide resistance warning

- **Systemic fungicides are the most effective chemicals for control of white blister**
- **White blister can rapidly develop resistance to systemic fungicides**
- **Systemic fungicides should be use with caution to maintain the resistance management strategies**



Know-how for Horticulture™



SOUTH PACIFIC SEEDS



## Acknowledgments

- Federal & State Governments
- Growers
- Project steering committee
  
- Dr Roy Kennedy, Warrick HRI
- Prof. Richard Falloon, Crop & Food NZ
- Ass. Prof. David Cahill, Deakin University



# Disease cycle of *Albugo candida*

