Project Title:

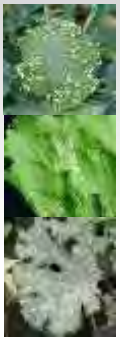
Benchmarking predictive models, nutrients and irrigation for management of downy and powdery mildews and white blister VG07070

Project Leader: Dr Liz Minchinton

Project Team and Time Commitment (FTE):

Liz Minchinton (0.9), Vic Galea (0.2), Des Auer (1.0), Joanna Petkowski (0.1), Rob Faggian (0.1), Barbara Hall (0.2), Ian McCauley (0.1), Hoong Pung (0.2), Chrys Akem (0.2), Roy Kennedy & Alison Wakeham UK (0.3).

Brief Overview:



Briefly list the proposed aim(s) of the project and the expected outputs/outcomes

- Disease predictive models:
  - Powdery mildew of cucurbits – develop & validate
  - Downy mildew on lettuce – modify & validate
  - White blister - aerial spore test kit
    - evaluate the new Brassica$_{spot}$ model
- Alternatives to leaf wetness sensors
- Review of weather station technology
- Effect of nutrients (N)
- Effect of irrigation timing
- Economics, benchmark & report

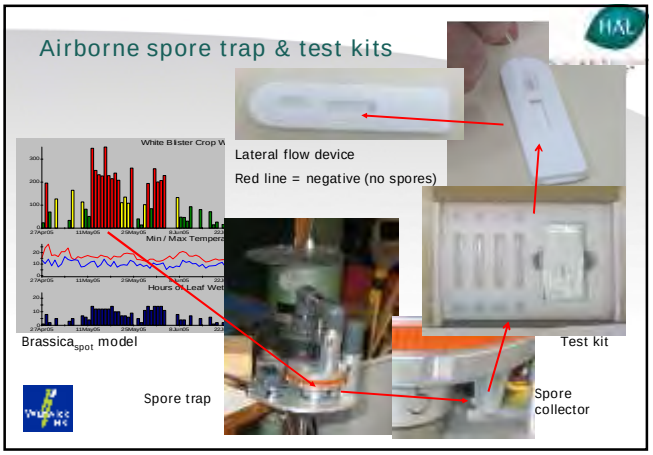
Progress to date:

Aerial spore test kit for white blister

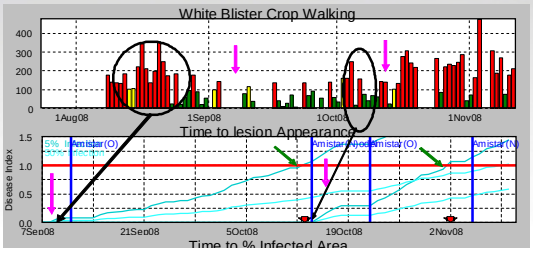
Alison Wakeham, Roy Kennedy, Joanna Petkowski & Robert Faggian

- Anitbody for the ELISA test kits
- Collect & send to UK:
  - *Albugo* spores & DNA (Race 9)
  - Other downy mildews & white blisters for pathogen differentiation
- Roy – shelf-life of the ELISA spore test kits
  - developing a ELISA spore test reader

Airborne spore trap & test kits



New white blister model



No bars = no risk, green bars = low risk, yellow bars = moderate risk, red bars = high risk of white blister, new blisters, spray predicted

Validation of new white blister model

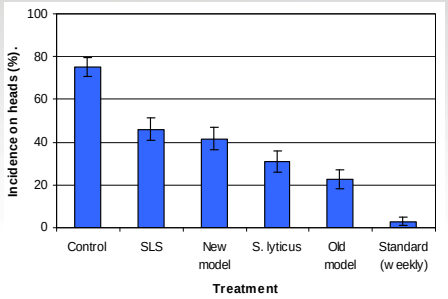
Three 3 trials

- Weekly (Cu), Control (unsprayed), Old & New Brassica$_{spot}$ model (Amistar)
- Rosebud – 2 soft options
- Werribee – 2 cvs, 2 irrigation times, 4 treatments

- Brassica$_{spot}$ model reduce no. sprays by 7-13
- Weekly Cu sprays gave best control of white blister on heads
- Model sprays did not coincide with button formation
- Spray buttons with systemic or trans-laminar
- Economics will be interesting

Rosebud Trial

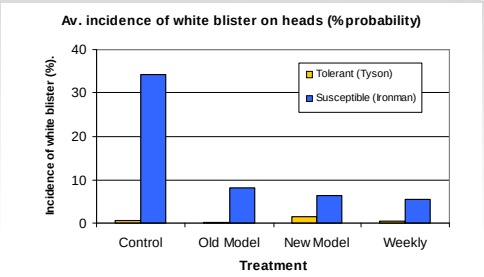
Av. incidence of white blister on heads of cv Grevillea



SLS= sodium lauryl sulphate, *S.lyticus* = *Streptomyces lyticus*, STD = Cu, SLS, *S. lyticus* & Cu sprayed weekly

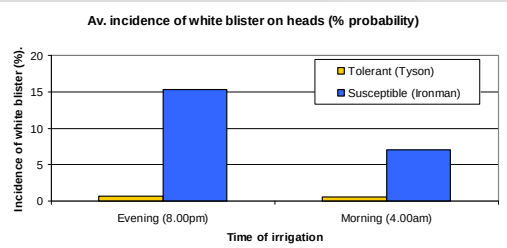
No. sprays: Weekly = 13, New model = 2, Old model = 1, Softs = 9

Werribee Trial



- Grow a tolerant variety
- No difference in white blister control between the models (2 sprays) or weekly Cu (15 sprays)

Effect of irrigation timing on disease



- Avoid irrigating a susceptible variety in the evening
- 50% reduction in white blister on a susceptible variety irrigated in the morning

Lettuce downy mildew model:

- Sporulation & infection model written in Excel
- Monitoring disease development in commercial crops
- Epidemiology with trap plants
- Trouble shooting spore collection & inoculation methods

Cv Anita – very susceptible to Botrytis

Lettuce downy mildew model

Computerised version of the model:

- Based on US & Canadian work
- Very similar to the DownCast model for onions
- Currently in Excel & only for research
- Norway also has a model - establishing contact

Model parameters (from literature):

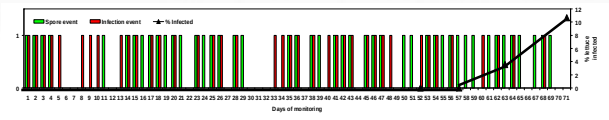
- Night temperatures >5 ºC
- Day temperatures < 22 ºC
- Midday temperature < 22 ºC
- Leaf wetness ≥ 3 hrs after sunrise

Development of downy mildew in the field

Crop monitoring in commercial lettuce crops:

- Rosebud, Cranbourne & Werribee South
- Collecting weather & incidence data
- Running the presumptive model

= Downy mildew appears late in the crop's life (Cos)



Development of downy mildew in the field

Monitoring spore release & infection in the field

- Spore trap
- Trap plants (hourly)
- Weather station

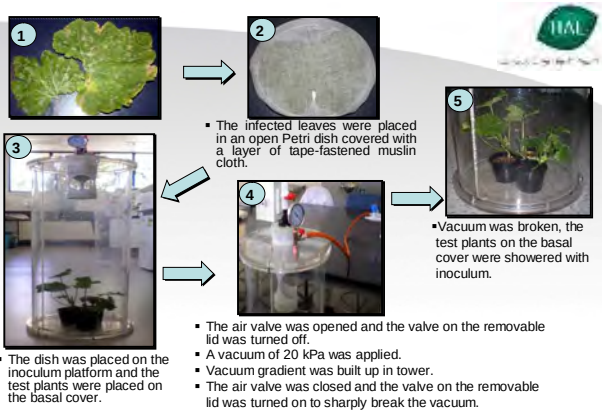
Werribee South 7.00am

Powdery mildew of cucurbits

- Aim: Develop a disease predictive model for powdery mildew
- PhD student Zatton Sapak (UQ Gatton)
- *Podosphaera xanthi*
- Draft review
- Developed inoculation technique that allowed uniform deposition of conidia on the leaf surfaces.
- Effect of temperature and RH on the germination of *P. xanthii.*

Zucchini

Cucumber



- The infected leaves were placed in an open Petri dish covered with a layer of tape-fastened muslin cloth.
- Vacuum was broken, the test plants on the basal cover were showered with inoculum.
- The dish was placed on the inoculum platform and the test plants were placed on the basal cover.
- The air valve was opened and the valve on the removable lid was turned off.
- A vacuum of 20 kPa was applied.
- Vacuum gradient was built up in tower.
- The air valve was closed and the valve on the removable lid was turned on to sharply break the vacuum.

Future Experiments

Germination of conidia at different:

- Relative humidities (50, 60, 70, 80 &
- Temperatures (15, 20, 25 & 30ºC)

Sporulation of conidia at different:

- Relative humidities (50, 60, 70, 80 & 90%)
- Temperatures (15, 20, 25 & 30ºC)

Study of disease infection and severity

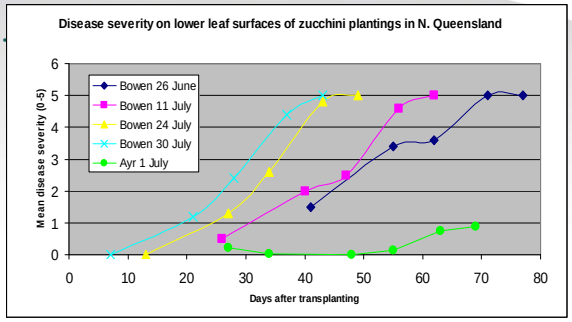
Powdery mildew conidiophore

A disease predictive model for powdery mildew of cucurbits - Epidemiology

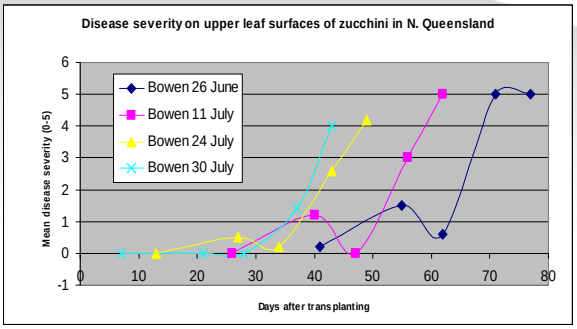
Gerry MacManus & Chrys Akem, Hort & Forestry Science; QDPI&F

- Field epidemiological studies at two locations in North Queensland - Ayr and Bowen
- Sequential plantings of a susceptible Zucchini cultivar every two weeks from start of regular season till end of season.
- Use of data loggers in experimental trial plots to record weather parameters
- Relevant weather data collected: Temperature, Relative Humidity and dew point
- Assess powdery mildew disease development and establish the effects of the weather parameters on the disease development

Influence of weather parameters on disease development



Influence of weather parameters on disease development



Alternatives to leaf wetness sensors (LWS)

Victor Galea UQ

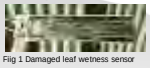


Fig 1 Damaged leaf wetness sensor

LWS: deterioration & quality of data (Fig 1)

Potential of Vapour Pressure Deficit (VPD) (Fig 2)
- Falls over in windy conditions
- OK for Glasshouses

Fig 2 Sensor frame with leaf wetness sensor mounted top most, RH sensor below R & temperature sensor below L.

Calibrations of LWS (Fig 3)
- Gravometric
- Adjust models for different types of LWS

Fuzzy Logic Model (predicts leaf wetness)
- Uses RH, temperature & wind speed
- 75% similarity to actual leaf wetness
- Author obtained 96% similarity

New generation of leaf wetness sensors

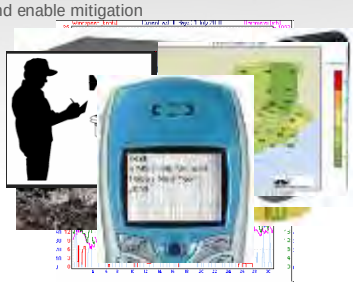
Fig. 3 Application of distilled water to a leaf wetness sensor by airbrush sprayer

Weather Station Systems for IPM in Australia

- Review of those currently available
- Must be available in Australia
- Designed for agricultural deployment
- Communicate by wireless
- Evaluate principally by:
  - capability
  - cost (full stations – mini stations)

Weather Stations and IPM

- Measure and monitor weather factors continuously
  - Store and analyse data with disease prediction model
  - Predict risk of disease and enable mitigation
- Weather station system
  - Sensors
  - Weather Station
  - Database Server
  - Modelling Software
  - Notification Interface



System Comparison - Features

Feature	*Representative*	*Other Options*
Sensors	Mini Station (T & LWS)	Full Station (T/H/R/WS/WD...)
Nodes	Single node	Multiple nodes Multiple systems
Wireless	Short (200-500 m)	Medium (2-20km) Unlimited (GSM)
Server	Local	Internet
Software	Basic	IPM models Web-enabled Multi-user

Cost of "Representative System"

- High End – Adcon
  - Weather Station - $2950
  - Full System - $8050 (minimum server config is 5 users)
- Mid Range – Crossbow eKo
  - Weather Station - $1823
  - Full System - $3925
- Low Range – Davis
  - Weather Station - $828
  - Full System - $1444 (can only support 1 node with 2 LWS)
- Custom Built
  - Weather Station - $250 (battery powered)
  - Full System - $875 (including cost of $400 mini-notebook)

Complex Choices

- Higher cost systems are:
  - may have superior sensors
  - capable of carrying more sensors
  - longer wireless range
  - more flexible and larger deployment
  - more options with software and IPM disease plugins
- Strongly influenced by system design
  - single vs multiple local weather nodes
  - local vs internet based analysis
  - individual vs shared systems

Effect of nutrients (N) on disease:

Dr Barbara Hall SARDI Adelaide SA

- *Downy mildew of lettuce*
- *Trial plan devised with nutrients to be used and amounts.*

Issues:

- *Have not been able to get the inoculation working consistently enough to run trial.*

Extension activities:

Include updates on workshops, extension activities and research and planned extension activities

2008

- 2 Workshop: Foliage Diseases 14th Mar & Report 21st Nov
- 2 Steering Committee Meetings (SCMs): 29th Apr & 16th May
- 3 Article for project (Lettuce leaf, Southern Farmer, VegeLinkVic)
- 3 Field Notes: Chemical resellers
- 1 Field Day: Werribee (Irrigation trial) 12th Nov

2009

- 2 SCMs – Jan & TBA
- Article to write on 2008 trials
- Field Days – (QLD, Tas, Vic)
- Workshops - 2
- Roadshow (interested?)

Werribee Field Day

Progress to date:

Economics and benchmark:

- Data collated for economic analysis – Lindsay Trapnell

Report:

- Articles to industry *in progress*

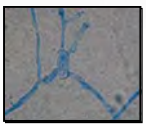
Workshop - Cranbourne

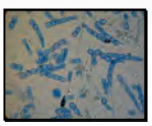
Steering committee meeting – Werribee

Next steps: Powdery mildew

Planned activities in the next 6 months

- Workshop – Ayer (Feb – Mar)
  - Report from PhD Zaton
- Field work – continue at Ayer & Bowen
- Zaton – PhD for model development & validation





120 h the primary mycelium seem to produce new branches and conidia (sporulation).

Next steps: Downy mildew

- Difficult ($x10^{10}$)
- Continue 'trouble shooting' – collection, storage, viability of spores
- Inoculation method
- Growth chamber studies of leaf wetness & temperature
- Field work – weather station, spore trap & trap plants
- Validation in field - delayed
- Establish links with Norway researchers

Susceptibility of cvs varies enormously

Next steps: White Blister

- Vic:
  - Broccoli – Model include a sprays at button stage
  - Chinese cabbage trial
  - Post harvest longevity
- Tasmania (Hoong Pung):
  - 2 trials
  - processing & fresh market (2 cvs)
  - 2 models
- UK:
  - spore trap lateral flow test
  - sending spores
  - obtain 'driver' – direct use

Broccoli trial site at Rosebud

Collaboration:

Describe how the project has linked with the other projects within and outside the subprogram

- Downy mildew review - HAL 1.1
- Bremia & Albugo spores to HAL 1.2, PhD - Uni WS
- Extension material - HAL 5.1, 2.2
- Broccoli to Vital Veg II Project
- Kim et al (S. Korea) – Fuzzy Logic Model
- Norway – downy mildew models

What do you require from the other projects going forward and what will you provide

- Any information to incorporate into field trials from HAL1.1, 1.2 & 3.1
- National Roadshow – HAL programs 1-6?

Issues:

Briefly mention any issues (past and potential) with the project

- UK contract – 11 months, $A value dropped,
- 'Drivers' for weather station not yet developed
- Issues with white blister in QLD (Clinton McGrath)
- Down mildew (Bremia) - nutrient & model work
- No powdery mildew on cucurbits – downy mildew

Briefly mention any issues outside your project (e.g. state issues, disease outbreaks etc) that may affect the overall Program

- PCN, locust plagues, Phylloxera & fires

Downy mildew on zucchini

Acknowledgments

- Project team:
  - Liz Minchinton - DPIvic
  - Roy Kennedy – UK
  - Alison Wakeham - UK
  - Victor Galea - UQ
  - Ian McCauley DPIVic
  - Chrys Akem - QDPI&F
  - Gerry MacMannus – QDPI&F
  - Barbara Hall - SARDI
  - Hoong Pung - Peracto
  - Robert Faggian -DPIVic
  - Joanna Petkowski - DPIVic
  - Des Auer – DPIVic
  - Zation Sapak - PhD student UQ

Thanks to HAL, Federal & State Governments,

Boomaroo Nursery for supplying seedlings,

Karl Riedel (crop consultant), Siggy & David Milburn