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
  - 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
- Antibody 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
Lateral flow device
Red line = negative (no spores)
Reposition model
Test kit
Spore trap
Spore collector

New white blister model
White Blister Crop Walking
Time to lesion
Appearance
Disease Index
5% Infected Area
50% Infected Area
75% Infected Area
Amistar (O)
Amistar (N)
Weekly (Cu), Control (unsprayed), Old & New Brassica
model (Amistar)
Rosebud - 2 soft options
Werribee – 2 cvs, 2 irrigation times, 4 treatments
Brassica
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

Validation of new white blister model
Three 3 trials
- Weekly (Cu), Control (unsprayed), Old & New Brassica
model (Amistar)
- Rosebud - 2 soft options
- Werribee – 2 cvs, 2 irrigation times, 4 treatments
- Brassica
model reduce no. sprays by 7-13
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- Economics will be interesting
**Rosebud Trial**

Av. incidence of white blister on heads of cv Grevillea

- Control
- SLS
- New model
- S. lyticus
- Old model
- Standard (weekly)

**Werribee Trial**

Av. incidence of white blister on heads (% probability)

- Control
- Old Model
- New Model
- Weekly

**Effect of irrigation timing on disease**

Av. incidence of white blister on heads (% probability)

- Evening (8.00pm)
- Morning (4.00am)

- 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

**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

**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

Monitoring spore release & infection in the field
- Spore trap
- Trap plants (hourly)
- Weather station

Werribee South 7.00am

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.

Powdery mildew of cucurbits

Powdery mildew of cucurbits

Zucchini
Cucumber

Future Experiments

Germination of conidia at different:
- Relative humidities (50, 60, 70, 80 & 90%)
- Temperatures (15, 20, 25 & 30°C)

Sporulation of conidia at different:
- Relative humidities (50, 60, 70, 80 & 90%)
- Temperatures (15, 20, 25 & 30°C)

Study of disease infection and severity

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

Disease severity on lower leaf surfaces of zucchini plantings in N. Queensland

Vegetable Pathology Program Workshop: November 27th and 28th, 2008
Influence of weather parameters on disease development

Vegetable Pathology Program Workshop- November 27th and 28th, 2008

Disease severity on upper leaf surfaces of zucchini in N. Queensland

![Graph showing disease severity over time]

Mean disease severity (0-5)

Bowen 26 June
Bowen 11 July
Bowen 24 July
Bowen 30 July

Days after transplanting

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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)

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Alternate to leaf wetness sensors (LWS)

LWS: deterioration & quality of data (Fig 1)
Potential of Vapour Pressure Deficit (VPD) (Fig 2)
- Falls over in windy conditions
- OK for Glasshouses
Calibrations of LWS (Fig 3)
  - Gravimetric
  - 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

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System Comparison - Features

<table>
<thead>
<tr>
<th>Feature</th>
<th>Representative</th>
<th>Other Options</th>
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<tbody>
<tr>
<td>Sensors</td>
<td>Mini Station</td>
<td>Full Station</td>
</tr>
<tr>
<td></td>
<td>(T &amp; LWS)</td>
<td>(T/ T/H/ W/ M/ WD...)</td>
</tr>
<tr>
<td>Nodes</td>
<td>Single node</td>
<td>Multiple nodes</td>
</tr>
<tr>
<td>Wireless</td>
<td>Short (200-500 m)</td>
<td>Medium (2-20km)</td>
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<tr>
<td></td>
<td>Unlimited (GSM)</td>
<td></td>
</tr>
<tr>
<td>Server</td>
<td>Local</td>
<td>Internet</td>
</tr>
<tr>
<td>Software</td>
<td>Basic</td>
<td>IPM models Web-enabled</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Multi-user</td>
</tr>
</tbody>
</table>

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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

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Cost of “Representative System”

- High End - Adcon
  - Weather Station - $2950
  - Full System - $8050 (minimum server config is 5 users)
- Mid Range - Crossbow eKos
  - 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 (excluding 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 large 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.

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**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)
- 1 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?)

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**Progress to date:**

**Economics and benchmark:**

- Data collated for economic analysis - Lindsay Trappnell

**Report:**

- Articles to industry in progress

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**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

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**Next steps:**

- **Downy mildew**
  - Difficulty (x10^15)
  - 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

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    - Zaton – PhD for model development & validation
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

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 W5
- 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 & 1.1
- 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

Acknowledgments

- Project team:
  - Liz Minchinton - DPIvic
  - Roy Kennedy – UK
  - Alison Wakeham - UK
  - Victor Galas - UQ
  - Ian McCauley DPIVic
  - Chrys Akem - QDPI&F
  - Gerry MacManus - QDPI&F
  - Barbara Hal - SAIS
  - Hoong Pung - Peracto
  - Robert Faggian - DPIVic
  - Joanna Petkowski - DPIVic
  - Zation Sapak - PhD student UQ

Thanks to HAL, Federal & State Governments, Boomaroo Nursery for supplying seedlings, Karl Riedel (crop consultant), Siggy & David Milburn

Vegetable Pathology Program Workshop - November 27th and 28th, 2008