An Integrated Disease Management program for the Australian almond industry (AL16005)

Dr Jacqueline Edwards
Agriculture Victoria

18th Australian Almond Conference
Pullman Hotel Melbourne, Albert Park, Victoria
October 30th - November 1st, 2018
Project Objective

“To improve on-farm management of economically important almond diseases, and to ensure these practices are communicated to, and adopted by, growers and industry”

- Conduct disease surveys across major almond-producing regions to determine prevalence and impact
- Determine the causes and epidemiology of the major diseases
  - hull rot and lower limb dieback/trunk disease
- Identify effective management practices
- Develop integrated disease management (IDM) guidelines suitable for almond production in Australia
Project team

**Victoria:**
Dr Jacqueline Edwards
Dr Tonya Wiechel
Simone Kreidl
Peta Faulkner
Anjali Zaveri (PhD)

**South Australia:**
Dr Mark Sosnowski
Dr Suzanne McKay
Brittany Oswald

**New South Wales:**
Dr Len Tesoriero

Stuart Pettigrew

AGRICULTURE VICTORIA

CROP DOC

AgDynamics
Industry-wide disease surveys
Almond diseases

Hull rot
Trunk disease / lower limb dieback
Phytophthora
Scab
Cankers
Bacterial spot
Anthracnose
Rust
Shot hole
Preliminary survey sampling (2018)

Targeted, grower-based, to refine methods, to determine causes
• Pathogens isolated, purified and identified
• 200+ reference isolates catalogued and stored
Grower census

Survey Monkey questionnaire designed and sent out to industry via ABA in June 2018

- To provide baseline information
- To source disease survey participants
- To ensure industry-wide coverage

<table>
<thead>
<tr>
<th>Region</th>
<th>Total industry % (ha)</th>
<th>Responses to census</th>
<th>Region coverage % (ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sunraysia (VIC)</td>
<td>56% (22,390)</td>
<td>6</td>
<td>27% (6,013)</td>
</tr>
<tr>
<td>Riverina (NSW)</td>
<td>20% (7,885)</td>
<td>2</td>
<td>16% (1,252)</td>
</tr>
<tr>
<td>Riverland (SA)</td>
<td>20% (7,910)</td>
<td>9</td>
<td>32% (2,521)</td>
</tr>
<tr>
<td>Adelaide Plains (SA)</td>
<td>2% (724)</td>
<td>3</td>
<td>9% (64)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>98% (39,662)</strong></td>
<td><strong>20</strong></td>
<td><strong>25% (9,850)</strong></td>
</tr>
</tbody>
</table>
Growers’ perception of almond diseases

- Impact: 40% respondents believe >25% of their orchard is affected by disease
- Prevalence: 95% hull rot, 95% trunk diseases (LLD + wood cankers), 65% Phytophthora
Industry-wide survey planning underway

- Appropriate survey methodology designed
- Grower census completed
- Three survey periods/season
  - November
  - Pre-harvest (Jan/Feb)
  - May
- Commencing Nov 2018
Lower limb dieback / trunk diseases and hull rot research
The Californian connection

Dr Themis Michailides
Dr Flourent Trouillas

November 2017 – SA

July 2018 – Jacky Edwards
• Hull rot
• Collaboration on PhD

September 2018 – Brittany Oswald
• LLD & trunk diseases
• Symptoms/diagnostics/methodology
### Common pathogens

- Diplodia seriata
- Eutypa lata
- Cytospora spp.

#### LLD / trunk diseases – complex aetiology

<table>
<thead>
<tr>
<th>Section</th>
<th>Image Description</th>
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<tbody>
<tr>
<td>2.1</td>
<td>Ap? (AL5-1)</td>
</tr>
<tr>
<td>2.2</td>
<td>Green fluffy (AL5-2), Pink fluffy (AL5-3), Ap? (AL5-4), dense white/red (AL5-5)</td>
</tr>
<tr>
<td>2.3</td>
<td>Dense dark green (AL5-10), Ap? (AL5-11)</td>
</tr>
<tr>
<td>2.4</td>
<td>Pink/dense (AL5-12)</td>
</tr>
<tr>
<td>2.6</td>
<td>Ap? (AL5-13), Pen</td>
</tr>
<tr>
<td>2.7</td>
<td>Pen</td>
</tr>
<tr>
<td>2.8</td>
<td>White dense (AL5-15), creamy dense (AL5-27)</td>
</tr>
</tbody>
</table>

*Common pathogens*:

- Diplodia seriata
- Eutypa lata
- Cytospora spp.
Hull rot – aetiology

In California:
- *Rhizopus stolonifer*
- *Aspergillus niger* complex
- *Monilinia* spp.
- *Neoscytalidium dimidiatum*

In Australia?
- *Rhizopus stolonifer*
- *(Monilinia fructicola)*
Hull rot symptoms

*Rhizopus stolonifer* colonises inside hull of young nut
- by-product: soluble fumaric acid
- translocated to nearby leaves and readily metabolised
- kills tissues and causes spur death ie hull rot “strikes”

- Methodology established for tracking fumaric acid production in almond tissue
Hull rot epidemiology – role of mummies?

In collaboration with AL16009 Almond IPM
• Insect interaction?
• Inoculum source?
• Sanitation?

<table>
<thead>
<tr>
<th>Mummy density</th>
<th>Blocks</th>
</tr>
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<tbody>
<tr>
<td>&lt;4</td>
<td>7</td>
</tr>
<tr>
<td>4 to 9</td>
<td>10</td>
</tr>
<tr>
<td>10 to 19</td>
<td>4</td>
</tr>
<tr>
<td>20 to 40</td>
<td>6</td>
</tr>
<tr>
<td>&gt;40</td>
<td>2</td>
</tr>
</tbody>
</table>
Hull rot - variety evaluation

AL12015: Almond Breeding Program

- 24 varieties, planted 2013
- Mummies / variety
- Rhizopus / mummy

In Jan/Feb: HR strikes /variety
Hull rot management

AL14005: Influence of nitrogen and water?

- 3 Varieties: Non pareil, Carmel and Monterey
- Four treatments: combinations of high and low water and nitrogen
- 6 Replicates

AL16009: Spray coverage?
Planned research for both diseases (HR & TD)

Pathogenicity
- glasshouse
- preliminary trial on established trees (AL12015, TD)

Environmental conditions (HR)
- Laboratory, glasshouse & field (Aus & USA)

Variatel susceptibility
- young trees purchased and potted

Fungicide effectiveness
- laboratory, glasshouse & field

Alternative treatments (HR)
e.g. early harvest, alkalis, BCAs, other
Acknowledgements

USA
Dr Flourent Trouillas
Dr Themis Michailides

Australia
AL16009 Almond IPM Program
AL12015 Almond Breeding Program
AL14005 Almond Productivity Program

Collaborating almond growers

AL16005 Almond IDM team

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