Understanding the risk of botrytis

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Outline

1. Brief review of botrytis development
2. Key risk factors
3. Integrated botrytis management
   - Spray timing
   - Introduce *Botrytis Decision Support Model*
Supporting material

1. Botrytis Management Fact Sheet
2. Botrytis Module:
   GWRDC Innovators Network website
3. Q&A handout
4. More on the Botrytis Decision Support Model
Botrytis cinerea

- A common environmental fungus
- Infects many flowering plants
- Wound pathogen
Pathways to infection

- Latent infection pathway
- Necrotic tissue pathway
Latent infection

Natural spore trap in the gap between the ovary and torus (receptacle)
Necrotic tissue at the tip of the torus exposed when cap falls

Photo: M. Longbottom, University of Adelaide
Regrowth of latent botrytis

1. Latent *B. cinerea* resumes invasion of grape berry
2. Berry-to-berry spread
3. Bunch-to-bunch spread
Bunch crowding: rapid spread
Necrotic tissue pathway

Photos: R.M. Beresford, R.W. Emmett, K.J. Evans
Key risk factors for botrytis
Trans-Tasman project

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Australian researchers

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Kathy Evans
Justin Direen, Katie Dunne

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Jacky Edwards
David Riches

New Zealand researchers (Plant & Food Research)

Marlborough
Dion Mundy
Rob Agnew

Hawke’s Bay
Peter Wood
Tracy Taylor

Auckland
Gareth Hill
Kwang Soo Kim
Rob Beresford
Study sites

Location of 51 trials

- Auckland: 12%
- Yarra Valley: 18%
- Tasmania (south): 16%
- Hawke's Bay: 25%
- Marlborough: 29%

Main varieties: Chardonnay, Riesling, Sauvignon Blanc
environment

pathogen

vine
Pathogen factors

Amount of
• botrytis last season
• latent infection
• bunch trash colonised by *B. cinerea*
  – eg aborted berries, calyptrae, trapped dead leaves
Latent infection & severity

44 site-years of data from non-treated plots in New Zealand, southern Tasmania & Yarra Valley, Victoria.

Maximum botrytis severity observed: 39%
Latent infection & severity

44 site-years of data from non-treated plots in New Zealand, southern Tasmania & Yarra Valley, Victoria.

Maximum botrytis severity observed: 39%

> 15% latents might predict > 3% harvest severity
Floral debris in bunch

$y = 0.1943x + 0.08$

$P = 0.052$

$R^2 = 0.32$

$n = 10$
Vine factors

- Berry sugar content
- Thin-skinned varieties prone to
  - berry splitting
  - loose pedicels
- Bunch compactness & crowding
- Excessive vigour
Compact bunches: rapid spread

Schematic representation of a rotten berry with botrytis in a compact bunch (left) and an open bunch (right). Botrytis moves quickly from berry to berry in compact bunches.

Photo: R.W. Emmett
Leaf layer number

$y = 0.159x + 0.31$

$P = 0.058$

$R^2 = 0.18$

$n = 16$

Botrytis severity (%) at harvest

Leaf layer number
Grape yield per vine

\[ y = 0.621x + 0.64 \]

\[ P = 0.013 \]

\[ R^2 = 0.21 \]

\[ n = 24 \]
No significant relationship found for

- **Bunch compactness**
  - study used compact varieties
  - variety effect not separated out

- **Bunch weight**
  - A trend, but not statistically significant
Environmental factors

- Duration of surface moisture in the fruiting zone
  - wind, temperature, RH
  - row orientation, large bodies of water, shelter belts
- Conditions that cause berry wounding
  - LBAM, powdery mildew, hail, birds
- Factors affecting vine vigour, bunch compactness, berry skin integrity
  - irrigation, nutrition, vine architecture, shoot training
Late season interval:

- Number of days between veraison & harvest
Late season interval

\[ y = 0.005e^{0.1567x} \]

\[ R^2 = 0.87 \]

Mean interval at 3% severity = 40.8 days
Severity determined by harvest date

Botrytis severity (%)

Harvest date

2-Feb 9-Feb 16-Feb 23-Feb 2-Mar 9-Mar 16-Mar 23-Mar 30-Mar 6-Apr 13-Apr
Integrate multiple measures!

- Harvest date (prediction systems)
- Canopy management
- Crop load manipulation
- Spray timing
- Spray coverage
- Vectors
- Nutrition
- Irrigation
- Biosuppressants

Chart based on the concept of P.A.G. Elmer
Spray timing
Spray timing

Which period is most critical?
• Flowering (80% capfall)?
• Mid season (pre-bunch closure)?
• Late season (veraison onwards)?

Answer:
• Depends on the region & the season
• Restrictions on late-season fungicide use
<table>
<thead>
<tr>
<th>No.</th>
<th>Timing</th>
<th>5% cap-fall</th>
<th>80% cap-fall</th>
<th>Pea size</th>
<th>PBC</th>
<th>Veraison</th>
<th>Pre-harvest</th>
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<td>Rovral</td>
<td>Rovral</td>
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<td>Non treated</td>
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</table>

Total no. treatments in trial: 7
Mean botrytis severity (%)

- Early: b
- Mid: a
- Late: ab
- Non treated: b
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<td>5</td>
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</table>

Total no. treatments in trial: 6
Mean botrytis severity (%)

<table>
<thead>
<tr>
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<th>Mean Botrytis Severity (%)</th>
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</thead>
<tbody>
<tr>
<td>Early Switch</td>
<td>ab</td>
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<tr>
<td>Mid Switch</td>
<td>ab</td>
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<tr>
<td>Late 1 Switch</td>
<td>a</td>
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<tr>
<td>Late 2 Rovral</td>
<td>bc</td>
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<tr>
<td>Non treated</td>
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</table>
Good coverage at PBC

- PBC is last chance for good spray coverage inside the bunch where latent infections often emerge.

Diagram:
- Spray droplet forms a meniscus.
- Latent infection emerges.
Predicting botrytis risk?

Chart based on the concept of P.A.G. Elmer
Introducing the prototype

*Botrytis Decision Support Model (BDSM)*
Purpose of BDSM

• Track & predict botrytis development
  – Are we in for a ‘bad’ botrytis year?
• Aid ‘in season’ decisions about botrytis management
  – Full season fungicide program?
  – Harvest early?
• Retrospective analysis
  – How can we do better next time?
Basis of BDSM

- Epidemics predictable once botrytis visible pre-harvest
- Some disease established early in the season
- Vineyard factors interact with weather to influence botrytis severity at harvest
Botrytis development is predictable

Botrytis severity (%)

Harvest date

Graph showing Botrytis severity (%), with harvest dates marked.
Surface wetness & temperature – Bacchus model

Describes the effect of temperature on the rate of infection of grape berries by *B. cinerea* conidia during wet periods.
BDSM = two models

• Early season model predicts late-season risk
• Late season model projects future disease once botrytis becomes visible
Early season model

• Provides a daily prediction of whether or not botrytis severity at harvest will be $\geq 3\%$
  – from 5% capfall to veraison

• Relies on a daily weather index
  – mean daily Bacchus index for previous 2 weeks accumulated daily
Model inputs (early)

• Surface wetness & temperature
• Rank disease last year:
  – Less than or greater than 3% severity?
• Rank crop load & vigour
  – Low, medium or high?
• Enter any management actions
  – Fungicides, leaf plucking etc
Model output (early)

Assessed any time between 5% capfall & veraison

<table>
<thead>
<tr>
<th>Risk</th>
<th>Management Options (example only)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>Canopy management eg. maintain 70% fruit exposure</td>
</tr>
<tr>
<td>Medium</td>
<td>Canopy management &amp; fungicide application at pre-bunch closure</td>
</tr>
<tr>
<td>High</td>
<td>Canopy management &amp; full-season fungicide program</td>
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Late season model

- Once botrytis visible
- Future disease severity projected by
  - Using monitored botrytis to ‘start’ the model
  - Bacchus Index determines the shape of the curve
    - Explosive or gradual epidemic
Model inputs (late)

- Surface wetness & temperature
- Vineyard monitoring protocol (botrytis)
- Harvest date (when known)
- Regular assessment of Brix
  - If also utilising Brix development model
Model outputs (late)

Late-Season

Predicted harvest severity: 9.8%

Predicted harvest °Brix: 22.0
Status of BDSM

- Currently a prototype
  - operates via an Excel spreadsheet
- NZ proceeding with web-based delivery
- ‘Expression of Interest’ handout outlines
  - what needs to happen next
  - how you can get involved
Take home message 1

Botrytis risk is highest in thin-skinned varieties with compact bunches in humid canopies carrying high crop loads
Botrytis risk can be reduced by appropriate canopy management & judicious use of inputs for vine balance
Very favourable weather for botrytis can undo your best efforts

– track disease progress & harvest early
The END is the beginning....

“If you do not change direction you may end up where you are heading”

Lao Tzu, 600-531 BC