Understanding and managing sour rot in wine grapes

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Tender Fruit & Grape IPM Specialist
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So what?

- Wineries may reject grapes when the VA exceeds their acceptance limit of acetic acid (0.20 – 0.24 g/L)
  - High VA indicates the presence of microbial contaminants that are not wanted in the winery
  - Off-flavours in wines from affected grapes
- 20% of early varieties rejected at winery
- Multiple fungicide sprays applied
- Labour costs of several passes to drop rotted fruit
Relationship between Sour Rot Severity and VA
P. noir, 2011

![Graph showing the relationship between Sour Rot Severity and VA (Volatile Acidity)]
Relationship between Sour Rot Severity and VA
P. noir, 2011
What’s causing it????
What’s causing it?

- Samples of sour rotted berries
- Flamed to remove surface organisms
Isolations from rotted berries, 2010
Isolations from rotted P. noir berries, 2011
Isolations from rotted Chardonnay berries, 2011
Isolations from rotted Riesling berries, 2011
Rating scale for sour rot
Pathogenicity of Organisms

![Bar Chart]

- Negative
- Gluconobacter
- Acetobacter
- Hanseniaspora uvarum
- Candida zemplinina
- Complex
Pathogenicity of Organisms

AA Bacteria

Hanseniaspora uvarum

Candida zemplina
Why does it happen?
Factors that promote sour rot

- Tight clusters/Thin skins
  - Varieties Affected
    - Pinot noir, Pinot gris, Gamay, Chardonnay, Riesling, Gewurztraminer, Baco noir
Factors that Promote Sour Rot

- Favoured by
  - Physical damage
  - Powdery mildew
Factors that Promote Sour Rot

- Clusters infected with bunch rot are more prone to infection by sour rot
Factors that Promote Sour Rot

- But
  - Frequently found sour rot without bunch rot sporulation
  - Frequently found sour rot in areas of clusters (shoulders) where no berry squeeze occurred
  - Very weak correlation ($r = 0.028 - 0.147$) between severity of bunch rot and sour rot 2008, 2010, 2011
Factors that Promote Sour Rot

• Grape Berry Moth
  - Bunch rot frequently associated with GBM injury
  - But a problem in vineyards with low GBM pressure
Factors that Promote Sour Rot

- Vinegar flies attracted by volatile compounds released during berry degradation
- Vector sour-rot organisms
  - passive transport by adults
  - eggs laid near base of berry where it pulls away from stem
  - transmitted throughout cluster during larval stages
  - larvae carry sour rot organisms in their gut.
Factors that Promote Sour Rot

Avg Temp (°C)

Brix

Frost

2009 Riesling
Factors that Promote Sour Rot

![Graph showing average temperature and Brix levels over time for 2010 Riesling](image)
Factors that Promote Sour Rot

![Graph showing Avg Temp (C), Brix, and TA from Aug 20 to Oct 15, 2011 for Riesling wine.]
Factors that Promote Sour Rot

Avg Temp (C)

TA

Brix

2011 P. noir
What can we do about it?
Sour Rot Management

• Reduce berry injury
• Eliminate causal organisms
Reduce Berry Injury

- Loosen grape clusters
  - Reduce berry squeeze
  - Thicker cuticle
Treatments to loosen clusters

• Fruiting zone sprays @ 100 gal/A
• Gibberellic Acid
  - 5, 10, 20 ppm
  - (6.7, 13.4, 26.8 oz/100 US gal)
  - Prebloom, 50-80% bloom, bloom + 7 days
• Prohexidione-Ca
  - High, medium and low rate
  - (9.7, 4.8 and 2.4 oz/100 US gal)
• Stimplex
  - 38, 48, 68 oz/A at 80% bloom.
Cluster Compactness Scale
Reduce Injury

• Loosen grape clusters
  – Bloom basal leaf removal
    • 6 basal leaves removed at trace bloom
    • starves clusters for photosynthate and fewer flowers set fruit.
    • looser cluster with fewer berries
Before Bloom Leaf Removal
After Bloom Leaf Removal
Veraison

Untreated
No leaf removal
Leaf removal at bloom
Veraison

Pea-sized berry
Leaf removal
Veraison

Veraison
Leaf removal
Effect of Bloom Treatments on Cluster Looseness, 2009

Cluster Looseness

- Untreated
- Basal leaf pull
- Prohex-Ca high
- Prohex-Ca med
- Prohex-Ca low
- GA 5 ppm
- GA 5 ppm 2X
- GA 10 ppm prebl
- GA 10 ppm
- GA 10 ppm 2X
- GA 20 ppm

Riesling
Pinot noir
Effect of Bloom Treatments on Incidence of Sour Rot, Riesling, 2009

Very low sour rot severity in both Riesling & P. noir
## Cluster Looseness and Disease Severity

**P. noir, 2010**

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Sour rot</th>
<th>Cluster Looseness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Check</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>pre-bloom leaf</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>GA 5 ppm prebl</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>GA 5 ppm</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>GA 5 ppm 2X</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>GA 10 ppm</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>GA 20 ppm</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Prohex-Ca low</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Prohex-Ca med</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Prohex-Ca high</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>

No Sig Dif among treatments -- Bloom timing for GA and Prohex Ca missed!!!
Sour Rot Severity, Riesling, 2010

No Sig Dif among treatments -- Bloom timing for GA and Prohex Ca missed!!!
Disease Severity and Cluster Looseness
Riesling, 2011
No significant difference btw treatments & peasize leaf pulling
Disease severity October 2011

- Peasize leaf
- Prebloom leaf
- Prohex-Ca med
- Prohex-Ca high
- GA 20 ppm

- Sour rot
- Botrytis
## Return Fruitfulness Riesling

<table>
<thead>
<tr>
<th>Treatment</th>
<th>2009/10</th>
<th>2010/11</th>
</tr>
</thead>
<tbody>
<tr>
<td>Untreated</td>
<td>88</td>
<td>96</td>
</tr>
<tr>
<td>prebloom leaf</td>
<td>88</td>
<td>93</td>
</tr>
<tr>
<td>GA 5 ppm prebl</td>
<td>90</td>
<td>94</td>
</tr>
<tr>
<td>GA 5 ppm bl</td>
<td>92</td>
<td>97</td>
</tr>
<tr>
<td>GA 5 ppm 2X</td>
<td>86</td>
<td>96</td>
</tr>
<tr>
<td>GA 10 ppm bl</td>
<td>92</td>
<td>94</td>
</tr>
<tr>
<td>Prohex-Ca low</td>
<td>88</td>
<td>94</td>
</tr>
<tr>
<td>Prohex-Ca med</td>
<td>86</td>
<td>95</td>
</tr>
<tr>
<td>Prohex-Ca high</td>
<td>89</td>
<td>97</td>
</tr>
</tbody>
</table>
Orchardists use helicopters to protect cherry crop

A helicopter flies low over a cherry orchard on Elliott Avenue in Peachland Tuesday morning. Rain can collect on cherries, causing them to split, so orchard owners hire helicopters to act as giant fans, blowing water off the cherry crop. (Dave Preston photo)
Reduce Mechanical Injury

• Suggestions for Cherry Cracking
  – Osmoticum sprays
    • Mineral salts (CaCl2) applied prior to or during rain
    • Reduce absorption of water across skin
  – Calcium
    • Strengthen cell walls?
    • Timing between fruit set and veraison
  – Surfactants
    • Raingard? (non-ionic surfactant)
    • Desikote (new formulation of VaporGuard)
Reduce Mechanical Injury

• Treatments

• CaCl$_2$
  - Stopit (12% CaCl$_2$ w/v)
    • 1.64 gal/100 gal (US) biweekly (peasize berry + veraison)
    • 0.87 gal/100 gal (US) weekly starting at peasize berry

• Leaf removal
  - Peasize berry vs veraison

• Raingard

• Desikote
Treatments to Reduce Berry Injury
P. noir, 2011

![Bar chart showing treatments for reducing berry injury. The chart compares untreated, peasize leaf, 2X CaCl2, 4X CaCl2, and RainGard treatments for sour rot and Botrytis.](chart.png)
Treatments to Reduce Berry Injury
Riesling, 2011

Check veraison leaf pea-size leaf 2X CaCl2 4X CaCl2 Raingard Desikote
Sour rot Botrytis
Large Plot Calcium and Leaf Removal, P. noir, 2011
Sour Rot Management

• Potassium Metabisulphite?
  - Used as anti-oxidant and anti-microbial (vs microbes) in vinification (40-60 g/tonne)
  - Rengasamy & Poole (NZ):
    • 5 kg per 1000 L water
    • Botrytis-infected berries dry out
  - Wicks (Australia):
    • 3-4 g/L KMS killed Botrytis spores & inhibited growth of germ tubes
    • If 4 g/L applied w/i 48 hr of infection, inhibits sporulation from infected berries
    • Little effect on sporulation after that
Sour Rot Management

• Potassium Metabisulphite (KMS)
  – Concerns:
    • Does it work?
      – Rate? Timing?
    • How does it work? (anti-oxidant/anti-microbial/both?)
    • Excess sulphites & SO₂ in wine?
Post-Veraison Treatments

- Treatments
  - KMS 2, 4, 8 lb/100 gal
  - Milstop (K bicarb)
  - KMS 4 lb + Milstop (K bicarb)
  - Oxidate
  - Blight Ban 506 (*Pseudomonas fluorescens*)
  - Actinovate (*Streptomyces lydicus*)
  - Agress (oxysilver nitrate)
  - Vermicompost (not shown)
- 150 gal/A in fruiting zone @
  - 50-75% veraison
  - + 2 wk
  - + 1 wk (Ries)
  - + 1 wk (Ries)
  - + 1 wk (1 wk pre-harvest)
  - 3 d pre-harvest
  - 1 d pre-harvest
Disease Severity with Post-Veraison Treatments
P. noir, 2011

No significant difference btw treatments & peasize leaf pulling check
Disease Severity with Post-Veraison Treatments
Riesling, 2011
Disease Severity with Post-Veraison Treatments

Riesling, 2011
All Treatments
Riesling, 2011
Effects of KMS on Vinification

• Treatments: 2 wk, 1 wk, 3 d, 1 d preharvest at 4 lb kg/100 gal (5000 ppm) (2.4 kg KMS/ha)
• Each plot consisted of all rot-free fruit on 4 to 6 Riesling vines
• If no sulfur dioxide dissipated, then the expected concentration of SO$_2$ in the juice would be 197 mg/L (based on a crop level of 4 t/acre)
Effects of KMS on Vinification

- Fermentations were sampled every other day for cell count and °Brix until the fermentations went to dryness
Fermentation slower in untreated control compared to KMS
Effects of KMS on Fermentation

No effect on yeast growth
## Effects of KMS on Fermentation

### Table 3. Wine parameters.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>pH</th>
<th>Titratable acidity (g/L tartaric acid)</th>
<th>Residual Sugar (g/L)</th>
<th>Ethanol (% v/v)</th>
<th>Total YAN (mg N/L)</th>
<th>Free SO2 (mg/L)</th>
<th>Total SO2 (mg/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>2.86 ± 0.04</td>
<td>9.7 ± 0.2a</td>
<td>1.1 ± 0.5</td>
<td>11.2 ± 0.3</td>
<td>6.1 ± 3.0</td>
<td>1.6 ± 0.6</td>
<td>3.0 ± 0.8</td>
</tr>
<tr>
<td>2 weeks</td>
<td>2.87 ± 0.07</td>
<td>8.9 ± 0.5b</td>
<td>1.2 ± 0.5</td>
<td>11.3 ± 0.3</td>
<td>7.4 ± 1.5</td>
<td>1.7 ± 0.4</td>
<td>3.2 ± 0.8</td>
</tr>
<tr>
<td>1 week</td>
<td>2.82 ± 0.07</td>
<td>8.8 ± 0.3b</td>
<td>1.3 ± 0.7</td>
<td>11.1 ± 0.2</td>
<td>7.6 ± 2.2</td>
<td>1.8 ± 0.9</td>
<td>2.9 ± 0.9</td>
</tr>
<tr>
<td>3 days</td>
<td>2.81 ± 0.06</td>
<td>8.9 ± 0.3b</td>
<td>1.6 ± 0.6</td>
<td>10.7 ± 0.4</td>
<td>7.3 ± 0.6</td>
<td>1.7 ± 0.5</td>
<td>2.9 ± 0.8</td>
</tr>
<tr>
<td>1 day</td>
<td>2.86 ± 0.11</td>
<td>8.8 ± 0.3b</td>
<td>1.6 ± 1.1</td>
<td>11.0 ± 0.6</td>
<td>8.6 ± 2.9</td>
<td>1.8 ± 0.7</td>
<td>3.0 ± 0.8</td>
</tr>
</tbody>
</table>

Mean values followed by letters are significantly different by LSD (p<0.05).

Very low levels of SO₂

Nsd in TA, residual sugar, ethanol
Effects of KMS on Fermentation

• KMS vineyard sprays did not adversely affect the yeast’s ability to carry out the fermentation

• Sulfur dioxide sprayed in the vineyard is not detectable in juice processed from grapes only 1 day after KMS spray application

• Make sure to cold stabilize before bottling

• Effects on storability of wine????
Future Research

• Effects of temperature & wetness duration on infection
• Effect of soil moisture/soil type/vine vigour on disease development
• Changes in berry between 13 and 15 Brix that relate to susceptibility
• Screen other potential control agents
• Repeat prebloom leaf removal, GA and Prohex-Ca on same plots
• Effect of temperature on KMS activity
• Interactions between causal organisms
• Progression of berry microflora pea-size to harvest
Thank you