Integrated Disease Management Based on Cultivar Susceptibility

David S. Jones
Graduate Student, University of Wisconsin - Madison
# Lots Of Unknowns for Cold-Climate Cultivars

<table>
<thead>
<tr>
<th>Cultivar</th>
<th>BR</th>
<th>DM</th>
<th>PM</th>
<th>Phom.</th>
<th>Anthr.</th>
<th>S</th>
<th>Cu</th>
</tr>
</thead>
<tbody>
<tr>
<td>Foch</td>
<td>++</td>
<td>+</td>
<td>++</td>
<td>+</td>
<td>++</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Frontenac</td>
<td>+++</td>
<td>+</td>
<td>++</td>
<td>+</td>
<td>+</td>
<td>No</td>
<td>?</td>
</tr>
<tr>
<td>Frontenac gris</td>
<td>++</td>
<td>+</td>
<td>++</td>
<td>+</td>
<td>+</td>
<td>No</td>
<td>?</td>
</tr>
<tr>
<td>La Crescent</td>
<td>++</td>
<td>+++</td>
<td>++</td>
<td>+++</td>
<td>+</td>
<td>?</td>
<td>?</td>
</tr>
<tr>
<td>La Crosse</td>
<td>+++</td>
<td>++</td>
<td>++</td>
<td>++</td>
<td>+</td>
<td>?</td>
<td>?</td>
</tr>
<tr>
<td>Marquette</td>
<td>+++</td>
<td>+</td>
<td>+</td>
<td>?</td>
<td>?</td>
<td>?</td>
<td>?</td>
</tr>
<tr>
<td>St. Croix</td>
<td>?</td>
<td>++</td>
<td>++</td>
<td>+++</td>
<td>+</td>
<td>?</td>
<td>?</td>
</tr>
</tbody>
</table>

Degree of susceptibility/sensitivity: + = slightly; ++ = moderately; +++ = highly; ? = not known
Objectives

1. Determine relative disease susceptibility to downy mildew, powdery mildew, and black rot in popular cold climate wine grape cultivars

2. Determine distinctions between foliar and fruit susceptibility to disease

3. Generate extension literature to promote understanding of disease symptoms and signs
Experimental Design

- 3 vineyard sites (200 vines/site)
- 8 popular cultivars
- Visual ratings from bud break through harvest in 2015 and 2016

Visual scale of 1-4
- 1 = no disease,
- 2 = 1-25% disease,
- 3 = 26-50% disease,
- 4 = >50% disease

- Additional fruit ratings: percentage of cluster damage estimated
Field Sites

- West Madison Agricultural Research Station, zone 5b
  - One vineyard, “WMARS”

- Peninsular Agricultural Research Station, zone 5a
  - Two vineyards, “PARS 1” and “PARS 2”
The Pathogens

- Downy mildew (*Plasmopara viticola*), Powdery mildew (*Erisyphe necator*), Black rot (*Guignardia bidwellii*)
- No artificial inoculation
- Previous reports of problems with all three diseases at both WMARS and PARS
Foliar Downy Mildew Susceptibility

Downy mildew rating

May  Jun  Jul  Aug  Sep  Oct

1.0
1.5
2.0
2.5
3.0
3.5
4.0

WMARS 2015
PARS 1 2015
Foliar Downy Mildew Susceptibility
Fruit Downy Mildew Susceptibility

- Valiant >90% damage in both years at all sites
- All other cultivars not susceptible

<table>
<thead>
<tr>
<th></th>
<th></th>
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<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Brianna</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Frontenac</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Frontenac gris</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>La Crescent</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>LaCrosse</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Marquette</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>St. Croix</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Valiant</td>
<td>&gt;90</td>
<td>&gt;90</td>
<td>&gt;90</td>
<td>&gt;90</td>
<td>&gt;90</td>
</tr>
</tbody>
</table>
### Susceptibility Summary

<table>
<thead>
<tr>
<th>Risk of Foliar Damage</th>
<th>Cultivar</th>
</tr>
</thead>
<tbody>
<tr>
<td>Severe</td>
<td>Valiant* = LaCrosse</td>
</tr>
<tr>
<td>High</td>
<td>La Crescent</td>
</tr>
<tr>
<td>High to Moderate</td>
<td>St. Croix</td>
</tr>
<tr>
<td>Moderate to Low</td>
<td>Brianna</td>
</tr>
<tr>
<td>Low</td>
<td>Frontenac = Frontenac gris</td>
</tr>
<tr>
<td>Very Low</td>
<td>Marquette</td>
</tr>
</tbody>
</table>

*Fruits are susceptible to disease.
Foliar Powdery Mildew Susceptibility

![Graph showing powdery mildew rating from May to October]

- **WMARS 2015**
- **PARS 1 2015**
Foliar Powdery Mildew Susceptibility

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**WMARS 2015**

- *Brionna*
- *Frontenac*
- *Frontenac gris*
- *La Crescent*
- *LaCrosse*
- *Marquette*
- *St Croix*
- *Valiant*

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**WMARS 2016**

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**PARS 1 2015**

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**PARS 1 2016**

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**PARS 2 2016**

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- Brianna, Frontenac, Frontenac gris most severely damaged
- Consistent with foliar ratings
- La Crescent minimally damaged
- Consistent with foliar ratings
- Middling cultivars

**Fruit Powdery Mildew Susceptibility**

![Graph showing percent clusters damaged by powdery mildew for different grape cultivars across August and September for PARS 1 and PARS 2. The bars indicate the percentage of clusters damaged, with green arrows pointing downwards indicating an increase in damage.](image-url)
## Susceptibility Summary

### Powdery Mildew

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<th>Risk of Foliar Damage</th>
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<tr>
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</tr>
<tr>
<td>High</td>
<td>Marquette*</td>
</tr>
<tr>
<td>Moderate</td>
<td>LaCrosse*</td>
</tr>
<tr>
<td>Low</td>
<td>St. Croix*</td>
</tr>
<tr>
<td>Very Low</td>
<td>La Crescent* = Valiant*</td>
</tr>
</tbody>
</table>

**Fruit and/or rachises are highly susceptible to disease**

*Fruit and/or rachises are slightly to moderately susceptible to disease*
Foliar Black Rot Susceptibility
Foliar Black Rot Susceptibility

Black rot rating

1.0
1.5
2.0
2.5
3.0
3.5
4.0

May  Jun  Jul  Aug  Sep  Oct

WMARS 2015

PARS 2015

WMARS 2016

PARS 1 2016

PARS 2 2016
Fruit Black Rot: Incidence

PARS 1 2016

PARS 2 2016

WMARS 2016

Percent clusters damaged by black rot

0
20
40
60
80
100

Brianna
Front
Frontgr
LaCresc
LaCrosse
Marq
StCroix
Valiant

Percent clusters damaged by black rot

0
20
40
60
80
100

Brianna
Front
Frontgr
LaCresc
LaCrosse
Marq
StCroix
Valiant

Percent clusters damaged by black rot

0
20
40
60
80
100

Brianna
Front
Frontgr
LaCresc
LaCrosse
Marq
StCroix
Valiant
Fruit Black Rot: Incidence

PARS 1 2016

PARS 2 2016

WMARS 2016
Fruit Black Rot: Severity

PARS 1 2016

PARS 2 2016

WMARS 2016
<table>
<thead>
<tr>
<th>Risk of Foliar Damage</th>
<th>Cultivar</th>
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<tr>
<td>Severe</td>
<td>Valiant***, Marquette***</td>
</tr>
<tr>
<td>High</td>
<td>Frontenac**, Frontenac gris**</td>
</tr>
<tr>
<td>Moderate</td>
<td>LaCrosse*</td>
</tr>
<tr>
<td>Low</td>
<td>Brianna*, St. Croix*</td>
</tr>
<tr>
<td>Very Low</td>
<td>La Crescent*</td>
</tr>
</tbody>
</table>

*** Fruits are severely at risk for black rot damage  
** Fruits are moderately at risk for black rot damage  
* Fruits are slightly at risk for black rot damage
### Future Work: Conventional Spray Reduction

<table>
<thead>
<tr>
<th>Growth Stage</th>
<th>Target Pathogen</th>
<th>Fungicide</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dormant</td>
<td>A</td>
<td>Sulforix</td>
</tr>
<tr>
<td>1&quot; Shoot</td>
<td>P</td>
<td>Mancozeb</td>
</tr>
<tr>
<td>3-5&quot; Shoot</td>
<td>P, PM</td>
<td>Mancozeb + Quintec</td>
</tr>
<tr>
<td>Bud Break - Bloom</td>
<td>BR, P, PM, DM</td>
<td>Revus Top</td>
</tr>
<tr>
<td>Mid-Bloom</td>
<td>B, BR, P, PM, DM</td>
<td>Captan + Endura</td>
</tr>
<tr>
<td>Late-Bloom - Shatter</td>
<td>BR, P, PM, DM</td>
<td>Mancozeb + Quintec</td>
</tr>
<tr>
<td>First Cover (7-10 days after shatter)</td>
<td>BR, PM, DM</td>
<td>Revus Top</td>
</tr>
<tr>
<td>Second Cover (10-14 days later)</td>
<td>BR, PM, DM</td>
<td>Mancozeb + Forum</td>
</tr>
<tr>
<td>Third cover</td>
<td>BR, PM, DM</td>
<td>Mancozeb + Quintec</td>
</tr>
<tr>
<td>Fourth Cover</td>
<td>BR, PM, DM</td>
<td>Mancozeb + Forum</td>
</tr>
<tr>
<td>Fifth Cover</td>
<td>BR, PM, DM</td>
<td>Captan + Endura</td>
</tr>
<tr>
<td>Sixth Cover</td>
<td>PM, DM</td>
<td>Captan + Quintec</td>
</tr>
<tr>
<td>Seventh Cover</td>
<td>PM, DM</td>
<td>Prophyt + Endura</td>
</tr>
<tr>
<td>Eighth Cover</td>
<td>PM, DM</td>
<td>Revus Top</td>
</tr>
<tr>
<td>Additional Covers</td>
<td>PM, DM</td>
<td>Prophyt + Endura</td>
</tr>
<tr>
<td>Last Cover</td>
<td>PM, DM</td>
<td>Prophyt + Armicarb</td>
</tr>
</tbody>
</table>

16+ Sprays

Nicole Ward, Extension Pathologist, University of Kentucky 2013
**Modified Conventional Spray Trial Example: Marquette**

<table>
<thead>
<tr>
<th>Cultivar: Marquette</th>
<th>Disease</th>
<th>Risk of Damage to Foliage</th>
<th>Risk of Damage to Fruit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Downy Mildew</td>
<td>Low</td>
<td>None</td>
<td></td>
</tr>
<tr>
<td>Powdery Mildew</td>
<td>High</td>
<td>Moderate</td>
<td></td>
</tr>
<tr>
<td>Black Rot</td>
<td>Moderate</td>
<td>High</td>
<td></td>
</tr>
</tbody>
</table>

*Also conduct vineyard sanitation (remove vineyard mummies) at this stage*

<table>
<thead>
<tr>
<th>Growth Stage</th>
<th>Target Pathogen</th>
<th>Fungicide</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dormant</td>
<td>Black Rot</td>
<td>Sulforix*</td>
</tr>
<tr>
<td>Bud Break - Bloom</td>
<td>Black Rot, powdery mildew</td>
<td>Mancozeb + Torino</td>
</tr>
<tr>
<td>Late Bloom - Shatter</td>
<td>Black rot, powdery mildew</td>
<td>Mancozeb + Vivando</td>
</tr>
<tr>
<td>First Cover (7-10 days after shatter)</td>
<td>Black rot, powdery mildew</td>
<td>Captain + Endura</td>
</tr>
<tr>
<td>Second Cover (10-14 days later)</td>
<td>Black rot, powdery mildew</td>
<td>Mancozeb + Quintec</td>
</tr>
<tr>
<td>Additional Covers: PM is identified</td>
<td>Powdery mildew</td>
<td>Potassium Salts</td>
</tr>
</tbody>
</table>

5 recommended sprays + supplemental sprays against PM vs. 16 recommended sprays
Conclusions

- Both severe susceptibility and relative resistance exist in the super-hardy cultivars.
- Cultivar choice may influence disease management.
- Important distinctions between fruit and foliar susceptibility should be expressed.
- Additional cold-climate cultivars should be added and compared.
# Acknowledgements

## Co-Authors:
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## Committee
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- Dr. Amanda Gevens

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- Guilherme Nuñes-Ludwig

[Logos of USDA, NIFA, SARE, and Northern Grapes Project]