Performance of Marquette, Frontenac, and La Crescent in Northern Grapes Project Viticulture Trials

Paul Domoto
Iowa State University

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What we know about
Northern Hybrids

1. Many can withstand winter temperatures as low as -40 F.
2. Many exhibit very vigorous vegetative growth.
3. Juice from the grapes can be:
   a. Very high in % soluble solids (°Brix).
   b. Very high in titratable acids (TA)
   c. Juice pH tends to rise rapidly during berry maturation.
   d. Juice has a different profile of malic to tartaric acid that other grapes.
   e. Juice can be high in potassium (K).
   f. Red wine cultivars are often very high in anthocyanin pigments.
4. Wines made from these grapes can often have an “herbaceous” or “grassy” character.
What we know about Grapevine Physiology

Symptoms associated with grapes grown in overly shaded canopies:

- Levels of titratable acids remain high.
- Juice pH rises rapidly during berry maturation.
- Juice can be high in potassium (K).
- Juice has a different profile of malic to tartaric acid.
- Wines made from the grapes have an “herbaceous” or “grassy” character.

Can vineyard management practices improve the quality of fruit from cold climate cultivars?
Objective 2

Develop and extend research-based vineyard management practices that allow sustained production of high quality fruit from cold climate cultivars.

• Obj. 2a. Evaluate crop and canopy management strategies to minimize fruit acid content and improve fruit composition in high-acid cold climate grape cultivars.
  i. Training systems
  ii. Canopy management
  iii. Cropping level management
Objective 2a
Approaches

i. Identify training systems suited to cold climate grape cultivars.
   - Comparing vine performance, yield, light interception, disease incidence, and fruit composition in replicated trials.

<table>
<thead>
<tr>
<th>State</th>
<th>CT</th>
<th>NY</th>
<th>IA</th>
<th>NE</th>
<th>MI</th>
<th>WI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coop.</td>
<td>Bill Nail</td>
<td>Tim Martinson</td>
<td>Gail Nonnecke</td>
<td>Paul Read</td>
<td>Paolo Sabatini</td>
<td>Rebecca Harbut</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Paul Domoto</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Training systems</td>
<td>HWC (Hudson River Umbrella)</td>
<td>HWC MWC/VSP Umbrella Kniffin</td>
<td>HWC MWC/VSP GDC Scott Henry</td>
<td>HWC MWC/VSP GDC Smart-Dyson Scott Henry</td>
<td>HWC GDC</td>
<td>?</td>
</tr>
<tr>
<td>Cultivars</td>
<td>St. Croix</td>
<td>Frontenac Marquette La Crescent</td>
<td>Frontenac Marquette La Crescent</td>
<td>Frontenac St. Croix</td>
<td>Frontenac Marquette La Crescent St. Croix</td>
<td>Frontenac Marquette La Crescent</td>
</tr>
<tr>
<td>Status</td>
<td>Established</td>
<td>Conversion year</td>
<td>Conversion year</td>
<td>Established</td>
<td>Conversion year</td>
<td>Planted 2012</td>
</tr>
</tbody>
</table>

Abbreviations: HWC= high wire cordon; MWC=mid-wire cordon; GDC= Geneva double curtain
Objective 2a
Approaches

ii. Canopy management.
Will modifying the light environment through canopy management practices improve fruit and wine making characteristics?

• Shoot thinning
  – Early season: double & basal shoots
  – Mid-season: Axillary (lateral) shoots
• Shoot positioning
• Summer hedging
• Leaf removal

Team:  IA - Gail Nonnecke & Paul Domoto
        WI - Rebecca Harbut (WI)
**Objective 2a Approaches**

**iii. Cropping level management.**

*Under what conditions will crop thinning moderate acidity and assist growers in avoid delays in ripening?*

a. Crop load adjustment:
   - **IA** - Gail Nonnecke & Paul Domoto

b. Timing and severity of crop reduction.
   - **NY** - Tim Martinson & Chrislyn Particka
2012 Spring Frosts

NE-1020 plot – Ames IA
11 April freeze (20.5°F)

<table>
<thead>
<tr>
<th></th>
<th>50% Bud burst</th>
<th>Shoot Dev.</th>
<th>% Live 1° shoots</th>
<th>Yield/vine (lb)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marquette</td>
<td>30 Mar</td>
<td>3rd leaf</td>
<td>15</td>
<td>2.8</td>
</tr>
<tr>
<td>La Crescent</td>
<td>2 Apr</td>
<td>2nd leaf</td>
<td>30</td>
<td>4.3</td>
</tr>
<tr>
<td>St. Croix</td>
<td>2 Apr</td>
<td>2nd leaf</td>
<td>43</td>
<td>8.0</td>
</tr>
<tr>
<td>Frontenac</td>
<td>7 Apr</td>
<td>1st leaf</td>
<td>72</td>
<td>10.9</td>
</tr>
</tbody>
</table>
# Objective 2a

## Outcomes in 2012

<table>
<thead>
<tr>
<th>State</th>
<th>Status in 2012</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>i. Training Systems</strong></td>
<td></td>
</tr>
<tr>
<td>CT</td>
<td>Established plot. No crop</td>
</tr>
<tr>
<td>NY</td>
<td>Conversion year. Some crop, some data collected</td>
</tr>
<tr>
<td>MI</td>
<td>Conversion year. Insufficient crop to collect data</td>
</tr>
<tr>
<td>IA</td>
<td>Conversion year. Insufficient crop to collect data</td>
</tr>
<tr>
<td>NE</td>
<td>Established plot. Not affected by frost.</td>
</tr>
<tr>
<td><strong>ii. Canopy Management</strong></td>
<td></td>
</tr>
<tr>
<td>IA</td>
<td>Some crop, study conducted on Frontenac &amp; La Crescent, but not Marquette.</td>
</tr>
<tr>
<td><strong>iii Cropping level management</strong></td>
<td></td>
</tr>
<tr>
<td>NY</td>
<td>Thinned Frontenac. Evaluated thinning effect of frost on La Crescent</td>
</tr>
<tr>
<td>IA</td>
<td>Insufficient crop to conduct the study</td>
</tr>
</tbody>
</table>
Objective 2a

ii Training systems

Connecticut St. Croix Training System Trial

<table>
<thead>
<tr>
<th>Year</th>
<th>GDC</th>
<th>HWC</th>
<th>SH</th>
<th>VSP</th>
</tr>
</thead>
<tbody>
<tr>
<td>2009</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
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<tr>
<td>2010</td>
<td>9.0</td>
<td>5.0</td>
<td>4.0</td>
<td>4.0</td>
</tr>
<tr>
<td>2011</td>
<td>8.0</td>
<td>5.0</td>
<td>4.0</td>
<td>4.0</td>
</tr>
</tbody>
</table>

Yield per Vine (Kg)
## Objective 2a

### ii Training systems

#### Connecticut:

<table>
<thead>
<tr>
<th>System</th>
<th>°Brix</th>
<th>pH</th>
<th>TA (g/L)</th>
</tr>
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<tbody>
<tr>
<td>GDC</td>
<td>16.7</td>
<td>20.3</td>
<td>15.1</td>
</tr>
<tr>
<td>HWC</td>
<td>16.5</td>
<td>20.4</td>
<td>15.6</td>
</tr>
<tr>
<td>SH</td>
<td>16.1</td>
<td>20.0</td>
<td>15.0</td>
</tr>
<tr>
<td>VSP</td>
<td>16.7</td>
<td>20.0</td>
<td>15.3</td>
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**Objective 2a ii Training systems**

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<td>VSP</td>
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<td></td>
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</tr>
</tbody>
</table>
New York:

- Site: Coyote Moon Vineyards, Clayton
- Cultivars: Frontenac, Marquette
- Training Systems: High wire cordon, Mid-wire cordon/VSP, Umbrella kniffin
- Conversion year: Frontenac was HWC; Marquette was VSP
New York Training Systems
Shoot Counts Before Shoot Thinning

Total shoots =
First Shoot (count) + 2\textsuperscript{nd} Shoot (count) + Base (noncount) buds

### Frontenac

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Nodes</th>
<th>First shoot</th>
<th>Double/vine</th>
<th>Base buds</th>
<th>Shoots</th>
<th>Shoot/node</th>
<th>% Shootless</th>
</tr>
</thead>
<tbody>
<tr>
<td>High Cordon*</td>
<td>34.2</td>
<td>28.9</td>
<td>4.8</td>
<td>11.1</td>
<td>44.8</td>
<td>1.3</td>
<td>14.4%</td>
</tr>
<tr>
<td>VSP</td>
<td>34.3</td>
<td>25.5</td>
<td>2.5</td>
<td>12.4</td>
<td>40.4</td>
<td>1.2</td>
<td>24.3%</td>
</tr>
<tr>
<td>Umbrella</td>
<td>35.1</td>
<td>29.9</td>
<td>8.9</td>
<td>9.0</td>
<td>47.7</td>
<td>1.4</td>
<td>13.1%</td>
</tr>
</tbody>
</table>

### Marquette

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Nodes</th>
<th>First shoot</th>
<th>Double/vine</th>
<th>Base buds</th>
<th>Shoots</th>
<th>Shoot/node</th>
<th>% Shootless</th>
</tr>
</thead>
<tbody>
<tr>
<td>High Cordon</td>
<td>23.4</td>
<td>17.7</td>
<td>0.5</td>
<td>1.5</td>
<td>19.6</td>
<td>0.8</td>
<td>25.2%</td>
</tr>
<tr>
<td>VSP*</td>
<td>33.6</td>
<td>26.6</td>
<td>0.2</td>
<td>14.7</td>
<td>41.5</td>
<td>1.3</td>
<td>17.9%</td>
</tr>
<tr>
<td>Umbrella</td>
<td>29.7</td>
<td>24.0</td>
<td>0.5</td>
<td>1.3</td>
<td>25.9</td>
<td>1.2</td>
<td>0.0%</td>
</tr>
</tbody>
</table>

* Original training system
New York Training Systems
2012 Yield

Frontenac

Marquette

* Original system

K deficiency on Frontenac
Nebraska Training Systems

- **Cultivars:** Frontenac, St. Croix
- **Systems:** HWC, MWC/VSP, GDC, Smart Dyson, Scott Henry, (PRS)
Iowa Training Systems

- Conversion year (from HWC)
- Cultivars: Frontenac, La Crescent, Marquette
- Systems: HWC, MWC/VSP, GDC, Scott Henry (or Smart Dyson)?
- Vineyards: Snus Hill, Madrid; Hickory Creek, Adel
Objective 2a

ii Canopy Management

Iowa:

• **Dylan Rolfes**, graduate student, Drs Gail Nonnecke & Paul Domoto
  – Under Grads: Danika Schaaf & Hanna Wallace

• **Cultivars/ Vineyard in 2012:**
  – **Frontenac**: Penoach Vineyards, Adel
  – **La Crescent**: Snus Hill, Madrid

• **Treatments**: all combinations of:
  – Pre-bloom shoot thinning
  – Post-bloom shoot positioning
  – Axillary (lateral) shoot thinning in the fruiting zone.

• **Data:**
  – Time to perform tasks including harvest
  – Canopy light quality (PAR) & Point Quadrat Analysis (PQA)
  – Yield
  – Fruit quality indices
Iowa Canopy Management Treatments

- Control
- SP
- ST
- LT
- ST + SP
- SP + LT
- ST + LT
- ST + SP + LT
Iowa Canopy Management
Time to perform tasks

### Frontenac

- **Control**
- **SP**
- **ST**
- **LT**
- **ST + SP**
- **SP + LT**
- **ST + LT**
- **ST + SP + LT**

### La Crescent

- **Control**
- **SP**
- **ST**
- **LT**
- **ST + SP**
- **SP + LT**
- **ST + LT**
- **ST + SP + LT**

**Legend**:
- Shoot thinning (ST)
- Shoot positioning (SP)
- Lateral thinning (LT)
- Harvest
Iowa Canopy Management – % PAR

Frontenac

- Shoot thinning (ST) min/vine
- Shoot positioning (SP) min/vine
- Lateral thinning (LT) min/vine
- % of PAR in Full Sun
- Shoots / ft
- Yield/vine (lb)

La Crescent

- Shoot thinning (ST) min/vine
- Shoot positioning (SP) min/vine
- Lateral thinning (LT) min/vine
- % of PAR in Full Sun
- Shoots / ft
- Yield/vine (lb)
Objective 2a

iii. Cropping level management

New York Thinning Study at Coyote Moon:

- Frontenac (planned in La Crescent)
  - Pre-bloom
    - Heavy (thin to 1 cluster/shoot)
    - Moderate (remove 6 clusters)
  - At fruit set
    - Heavy (thin to 1 cluster/shoot)
    - Moderate (remove 6 clusters)
  - Green Harvest
    - Remove lagging clusters at veraison
  - Control
- 4 reps, 3-panel plots, data collected on middle 7 vines
New York Thinning Study at Coyote Moon:

• However:
  – Severe frost/freeze damage in La Crescent prevented study from occurring due to extremely light crop
    • Tagged 25 vines with varying crop, recorded fruit chemistry and yield.
  – Frost/freeze damage in Frontenac meant a somewhat reduced crop, plus very warm weather conditions resulted in good fruit chemistry overall.
  – Severe potassium deficiency.
Objective 2a

iii. Cropping level management.

New York Thinning Study at Coyote Moon:
• La Crescent ‘Crop Load’ August 13 2012

Fit Y by X Group

<table>
<thead>
<tr>
<th>Bivariate Fit of g/berry By # of clusters</th>
<th>Bivariate Fit of pH By # of clusters</th>
<th>Bivariate Fit of TA By # of clusters</th>
<th>Bivariate Fit of °Brix By # of clusters</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1.png" alt="Graph" /></td>
<td><img src="image2.png" alt="Graph" /></td>
<td><img src="image3.png" alt="Graph" /></td>
<td><img src="image4.png" alt="Graph" /></td>
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</tbody>
</table>

Berry wt. **vs** # of Clusters

pH **vs** # of Clusters

TA **vs** # of Clusters

°Brix **vs** # of Clusters
Viticulture Team
Plans for 2013

Objective 2a:

i. Training systems
   • Continue studies
   • Converted systems will provide better data

ii. Canopy management
   • Continue studies & include Marquette
   • Make wine from treatments (IA)

iii. Crop level management
   • Continue studies as originally planned (IA, NY)
     o Spring frost?
     o Drought conditions?