
Tim Martinson
Sr. Extension Associate
Dept. of Horticulture
Cornell University

Anna Katharine Mansfield, Cornell University
Jim Luby and William Gartner, University of Minnesota
Murli Dharmadhikari and Paul Domoto, Iowa State University

The Northern Grapes Project is funded by the USDA’s Specialty Crops Research Initiative Program of the National Institute for Food and Agriculture, Project #2011-51181-30850
Northern Grapes: Integrating viticulture, winemaking, and marketing of new cold hardy cultivars supporting new and growing rural wineries

- 5 Year Coordinated Ag Project
- 12 Institutions, 12 states
- 34 Research/Extension Scientists
- 23 Industry Associations
- $2.5M Funded (2 yr) USDA; $3M Renewal (2 yr)
- Matched > 25 Organizations and Individuals

The Northern Grapes Project is funded by the USDA’s Specialty Crops Research Initiative Program of the National Institute for Food and Agriculture, Project #2011-51181-30850
## University of Minnesota Cultivars

Katie Cook, Jim Luby & Peter Hemstad

<table>
<thead>
<tr>
<th>Cultivar</th>
<th>Frontenac</th>
<th>La Crescent</th>
<th>Marquette</th>
<th>Frontenac gris</th>
</tr>
</thead>
<tbody>
<tr>
<td>Original cross</td>
<td>1979</td>
<td>1988</td>
<td>1989</td>
<td>-</td>
</tr>
<tr>
<td><strong>Mid-winter cold tolerance</strong></td>
<td><strong>-36° C/-33°F</strong></td>
<td><strong>-38° C/-36 °F</strong></td>
<td><strong>-34° C/-29°F</strong></td>
<td><strong>-36° C/-33°F</strong></td>
</tr>
<tr>
<td><strong>Pedigree</strong></td>
<td><strong>V. riparia</strong></td>
<td><strong>St. Pepin x E. S. 6-8-25</strong></td>
<td><strong>MN 1094 x Ravat 262</strong></td>
<td>Single cane bud mutation of Frontenac</td>
</tr>
<tr>
<td><strong>V. riparia</strong> 89 x Landot 4511</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ave. Soluble Solids (°Brix)</td>
<td>26.0°</td>
<td>25.5°</td>
<td>26.1°</td>
<td>26.0°</td>
</tr>
<tr>
<td>Ave. Titratable Acid. (g/L)</td>
<td>15.4</td>
<td>13.0</td>
<td>12.1</td>
<td>14.0</td>
</tr>
</tbody>
</table>
‘Elmer Swenson’ Cultivars

<table>
<thead>
<tr>
<th>Cultivar</th>
<th>Brianna</th>
<th>Eidelweiss</th>
<th>St Croix</th>
<th>St Pepin</th>
</tr>
</thead>
<tbody>
<tr>
<td>Original cross</td>
<td>1983</td>
<td>1955</td>
<td>?</td>
<td>?</td>
</tr>
<tr>
<td>Mid-winter cold tolerance</td>
<td>?</td>
<td>-34° C/-29°F</td>
<td>-35° C/-32°F</td>
<td>-32° C/-25°F</td>
</tr>
</tbody>
</table>

Pedigree
(V. labrusca, V. riparia, V. vinifera)

- ‘Kay Gray’ x E.S. 2-12-13
- St. Pepin x E.S. 6-8-25
- E.S. 283 x E.S. 193
- (MN #78 x Seibel 1000) x ‘Seyval blanc’

*Pistillate vine

| Ave. Soluble Solids (° Brix) | 18-20 | 14-16 | 16-20 | 20 |
| Ave. Titratable Acidity (g/L) | 7.3-9.0 | 10.0-12.0 | 9.0-11.0 | 10.0-12.0 |
Unique Acid Composition

Malic vs Tartaric

Murli Dharmadhikari
Iowa State University

Chardonnay

>=70%
New York Grape Production

- Lake Erie /Niagara 29,000 Ac.
- Finger Lakes 10,000 Ac.
- Hudson Valley 600 Ac.
- Long Island 2000 Ac.
Novice Growers and Winemakers

*Project clientele*

<table>
<thead>
<tr>
<th>Vineyards</th>
</tr>
</thead>
<tbody>
<tr>
<td>5,900 acres (2,460 Ha)</td>
</tr>
<tr>
<td>40% Non-bearing (2011)</td>
</tr>
<tr>
<td>80% planted since 2002.</td>
</tr>
<tr>
<td>70% &lt; 2 HA</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Wineries</th>
</tr>
</thead>
<tbody>
<tr>
<td>300</td>
</tr>
<tr>
<td>1000-3000 cases</td>
</tr>
<tr>
<td>80% established since 2002.</td>
</tr>
</tbody>
</table>


## Economic Impact of Cold Climate Cultivars

*Brigid Tuck and Bill Gartner, University of Minnesota*

### Table: Economic Contribution

<table>
<thead>
<tr>
<th>Source</th>
<th>Economic Impact (Millions)</th>
<th>Jobs Generated</th>
</tr>
</thead>
<tbody>
<tr>
<td>Winery</td>
<td>$215</td>
<td>5,000</td>
</tr>
<tr>
<td>Vineyard</td>
<td>$46</td>
<td>5,900</td>
</tr>
<tr>
<td>Winery-Associated Tourism</td>
<td>$140</td>
<td>1,700</td>
</tr>
<tr>
<td>Overall</td>
<td>$401</td>
<td>12,600</td>
</tr>
</tbody>
</table>

Novice Growers and Winemakers

*Project clientele*

- Enthusiastic
- Part-timers
- Still developing skills
- Startups, informal businesses
- Receptive to technical information
- Receptive to folklore/hearsay
- Growers inordinately fond of VSP, low yields, manual canopy manipulations

**Basis for Northern Grapes Project**

New cultivars, Unique fruit chemistry, Novice growers/winemakers/retailers
Multi-Disciplinary Studies

**Address**

- **Varietal performance** and resulting fruit and wine flavor attributes in different climates
  
- Applying appropriate **viticultural practices** to achieve consistent fruit characteristics for ripening
  
- Applying **winemaking practices** to their unique fruit composition to produce distinctive wines that consumers will like and purchase
  
- Understanding consumer preferences, individual/regional **marketing strategies** to increase sales and sustained profitability of wineries and vineyards.
Project Outcomes:

• 5 YR: Production and sales double
• Improved quality from better growing and winemaking practices will improve customer retention and drive repeat sales
• Cold-climate cultivars will establish unique regional marketing identities
• Wineries will apply business and tasting room management practices that drive sales
**Northern Grapes Project**

- **Cultivar performance**
  - Coordinated variety trials (NE1020)
  - Genomics and flavor attributes

![Monoterpenoid biosynthesis gene expression](image)

<table>
<thead>
<tr>
<th>Gene</th>
<th>Front Skin</th>
<th>Marq Skin</th>
</tr>
</thead>
<tbody>
<tr>
<td>VIT_12s0134g00030</td>
<td>0.0</td>
<td>8.5</td>
</tr>
<tr>
<td>VIT_06s0004g06480</td>
<td>0.1</td>
<td>0.0</td>
</tr>
<tr>
<td>VIT_17s0000g05580</td>
<td>0.2</td>
<td>1.4</td>
</tr>
<tr>
<td>VIT_01s0010g02320</td>
<td>0.5</td>
<td>2.5</td>
</tr>
<tr>
<td>VIT_13s0067g00380</td>
<td>0.6</td>
<td>0.1</td>
</tr>
<tr>
<td>VIT_15s0046g03600</td>
<td>0.7</td>
<td>0.2</td>
</tr>
<tr>
<td>VIT_13s0067g00370</td>
<td>0.8</td>
<td>0.2</td>
</tr>
<tr>
<td>VIT_19s0135g00200</td>
<td>1.1</td>
<td>0.2</td>
</tr>
<tr>
<td>VIT_00s0253g00140</td>
<td>1.4</td>
<td>0.4</td>
</tr>
<tr>
<td>VIT_19s0135g00190</td>
<td>2.6</td>
<td>0.4</td>
</tr>
<tr>
<td>VIT_05s0049g00400</td>
<td>3.3</td>
<td>1.6</td>
</tr>
<tr>
<td>VIT_15s0046g03570</td>
<td>3.3</td>
<td>1.4</td>
</tr>
<tr>
<td>VIT_08s0032g00240</td>
<td>3.7</td>
<td>1.2</td>
</tr>
<tr>
<td>VIT_15s0021g01060</td>
<td>6.2</td>
<td>1.3</td>
</tr>
<tr>
<td>VIT_11s0016g01290</td>
<td>7.6</td>
<td>1.2</td>
</tr>
<tr>
<td>VIT_19s0015g02500</td>
<td>9.1</td>
<td>1.7</td>
</tr>
<tr>
<td>VIT_17s0000g09610</td>
<td>13.3</td>
<td>1.7</td>
</tr>
<tr>
<td>VIT_15s0048g01490</td>
<td>22.3</td>
<td>0.2</td>
</tr>
<tr>
<td>VIT_02s0025g04880</td>
<td>119.5</td>
<td>35.3</td>
</tr>
</tbody>
</table>
Northern Grapes Project

• Viticulture
  – Training, cropping, canopy management
  – Nutrition
  – Disease management

www.northerngrapesproject.org
Northern Grapes Project

- Enology
  - Acid reduction/Partial malolactic
  - Yeast selection
  - Wine styles that fit the cultivar

www.northerngrapesproject.org
Northern Grapes Project

- Consumers
  - Baseline survey/Economic impact
  - Tasting room attributes
  - Branding
  - Collaboration

www.northerngrapesproject.org
Coordinated Variety Trials

NE-1020 Project

Climate and standard maturity indices

Vine performance and climate
- Evaluate: Yield and quality vs. climate indices
- Data from 3-9 sites/variety
NE-1020 Blocks
With Northern Cultivars

<table>
<thead>
<tr>
<th>State</th>
<th>Edelweiss</th>
<th>Frontenac</th>
<th>Frontenac gris</th>
<th>La Crescent</th>
<th>Lacrosse</th>
<th>Cultivars under Evaluation (No. vines)</th>
<th>Marquette</th>
<th>MN 1258</th>
<th>MN 1189</th>
<th>MN 1200</th>
<th>MN 1220</th>
<th>MN 1235</th>
<th>Petit Amie</th>
<th>Prairie Star</th>
<th>St. Croix</th>
</tr>
</thead>
<tbody>
<tr>
<td>NE 1020 Coordinated Variety Trials</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Connecticut</td>
<td>50</td>
<td>25</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>50</td>
<td>25</td>
<td>50</td>
<td>50</td>
<td>50</td>
<td>50</td>
<td>50</td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td>Iowa</td>
<td>50</td>
<td></td>
<td>50</td>
<td></td>
<td></td>
<td></td>
<td>50</td>
<td>50</td>
<td>50</td>
<td>50</td>
<td>50</td>
<td>50</td>
<td>50</td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td>Michigan</td>
<td>25</td>
<td></td>
<td>25</td>
<td></td>
<td></td>
<td></td>
<td>25</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>25</td>
<td></td>
</tr>
<tr>
<td>Nebraska</td>
<td>18</td>
<td>36</td>
<td>36</td>
<td>36</td>
<td></td>
<td></td>
<td>36</td>
<td>36</td>
<td>36</td>
<td>36</td>
<td>36</td>
<td>36</td>
<td>36</td>
<td>36</td>
<td>36</td>
</tr>
<tr>
<td>NY-Geneva</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>25</td>
<td></td>
<td></td>
<td>25</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>25</td>
</tr>
<tr>
<td>Pennsylvania</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>25</td>
<td></td>
<td></td>
<td>25</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>25</td>
</tr>
<tr>
<td>Vermont</td>
<td>24</td>
<td>24</td>
<td>24</td>
<td>24</td>
<td></td>
<td></td>
<td>24</td>
<td>24</td>
<td>24</td>
<td>24</td>
<td>24</td>
<td>24</td>
<td>24</td>
<td>24</td>
<td>24</td>
</tr>
<tr>
<td>Massachusetts</td>
<td>24</td>
<td>24</td>
<td>24</td>
<td>24</td>
<td></td>
<td></td>
<td>24</td>
<td>24</td>
<td>24</td>
<td>24</td>
<td>24</td>
<td>24</td>
<td>24</td>
<td>24</td>
<td>24</td>
</tr>
<tr>
<td>Additional Cultivar Trials</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NY-Champlain</td>
<td>12</td>
<td>12</td>
<td>12</td>
<td>12</td>
<td>12</td>
<td></td>
<td>12</td>
<td></td>
<td>12</td>
<td></td>
<td>12</td>
<td></td>
<td>12</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>Illinois</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>24</td>
<td>24</td>
<td>24</td>
<td>24</td>
<td></td>
<td></td>
<td>24</td>
<td></td>
<td>24</td>
<td></td>
<td>24</td>
<td></td>
<td>24</td>
<td>24</td>
<td>24</td>
</tr>
</tbody>
</table>

*NE 1020 blocks were planted in 2008; NY Champlain in 2005; and Illinois in 2008*
Challenge #1: Climate
winter lows, heat units, early budburst

Average Annual Extreme Minimum Temperature 1976-2005

<table>
<thead>
<tr>
<th>Temp (F)</th>
<th>Zone</th>
<th>Temp (°C)</th>
<th>Temp (F)</th>
<th>Zone</th>
<th>Temp (°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>-40 to -35</td>
<td>3a</td>
<td>-40 to -37.2</td>
<td>-15 to -10</td>
<td>5b</td>
<td>-26.1 to -23.3</td>
</tr>
<tr>
<td>-35 to -30</td>
<td>3b</td>
<td>-37.2 to -34.4</td>
<td>-10 to -5</td>
<td>6a</td>
<td>-23.3 to -20.6</td>
</tr>
<tr>
<td>-30 to -26</td>
<td>4a</td>
<td>-34.4 to -31.7</td>
<td>-5 to 0</td>
<td>6b</td>
<td>-20.6 to -17.8</td>
</tr>
<tr>
<td>-25 to -20</td>
<td>4b</td>
<td>-31.7 to -28.9</td>
<td>0 to 5</td>
<td>7a</td>
<td>-17.8 to -15</td>
</tr>
<tr>
<td>-20 to -15</td>
<td>5a</td>
<td>-28.9 to -26.1</td>
<td>5 to 10</td>
<td>7b</td>
<td>-15 to -12.2</td>
</tr>
</tbody>
</table>
Weather and Growing Degree Days

30 year average 1980-2010

Monthly GDD in °F (Base 50)

- Geneva, NY: 2400 GDD
- Ames, IA: 3200 GDD
- Fargo, ND: 1800 GDD

Month: JAN FEB MAR APR MAY JUN JUL AUG SEP OCT Nov DEC
Challenge #1: Climate
winter lows, heat units, early budburst

Heat Units and Fruit composition 2012

<table>
<thead>
<tr>
<th></th>
<th>Cooler</th>
<th></th>
<th>Warmer</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Vermont</td>
<td></td>
<td>SW Michigan</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Brix</td>
<td>TA</td>
<td>pH</td>
<td>Brix</td>
</tr>
<tr>
<td>Frontenac</td>
<td>20.6</td>
<td>17.0</td>
<td>2.98</td>
<td>19.1</td>
</tr>
<tr>
<td>La Crescent</td>
<td>19.9</td>
<td>14.7</td>
<td>2.97</td>
<td>22.2</td>
</tr>
<tr>
<td>Marquette</td>
<td>20.8</td>
<td>14.1</td>
<td>2.98</td>
<td>25.8</td>
</tr>
<tr>
<td>St. Croix</td>
<td>17.0</td>
<td>8.3</td>
<td>3.28</td>
<td>20.7</td>
</tr>
</tbody>
</table>
Heat Unit Accumulations

30 Yr Average Growing Degree Days

![Graph showing the accumulation of growing degree days over time with specific dates marked for Bloom and Veraison, and lines representing different locations like AMES, IA, GENEVA, NY, and Fargo, ND.](image-url)
**NE-1020 Performance 2012**

*Early spring, frost injury*

<table>
<thead>
<tr>
<th>Yield per Vine (Lb)</th>
<th>Nodes per Vine</th>
<th>Shoots/Vine</th>
<th>Shoots Per Node</th>
<th>Crop Per Node (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- **10 Lb/vine**
- **30 nodes/vine**
- **30 shoots/vine**
- **1 shoot/node**
- **150 g/node**

= ca 4 Tons/acre
6 x 9 Ft spacing

= 5 per foot at 6 Ft
In-row spacing

= 10 lb/vine
30 shoots/vine
Yield and Retained Nodes 2013

<table>
<thead>
<tr>
<th>Yield /vine (Lb)</th>
<th>Nodes Per Vine</th>
<th>Shoots per Vine</th>
<th>ShPerNodePost</th>
<th>Crop Per Node</th>
</tr>
</thead>
<tbody>
<tr>
<td>MI1:Marquette</td>
<td>MI1:Marquette</td>
<td>MI1:Marquette</td>
<td>MI1:Marquette</td>
<td>MI1:Marquette</td>
</tr>
<tr>
<td>MA:St Croix</td>
<td>MA:St Croix</td>
<td>MA:St Croix</td>
<td>MA:St Croix</td>
<td>MA:St Croix</td>
</tr>
<tr>
<td>IA:St Croix</td>
<td>IA:St Croix</td>
<td>IA:St Croix</td>
<td>IA:St Croix</td>
<td>IA:St Croix</td>
</tr>
<tr>
<td>VT:St Croix</td>
<td>VT:St Croix</td>
<td>VT:St Croix</td>
<td>VT:St Croix</td>
<td>VT:St Croix</td>
</tr>
<tr>
<td>MI2:Frontenac</td>
<td>MI2:Frontenac</td>
<td>MI2:Frontenac</td>
<td>MI2:Frontenac</td>
<td>MI2:Frontenac</td>
</tr>
<tr>
<td>VT:La Crescent</td>
<td>VT:La Crescent</td>
<td>VT:La Crescent</td>
<td>VT:La Crescent</td>
<td>VT:La Crescent</td>
</tr>
<tr>
<td>MI2:St Croix</td>
<td>MI2:St Croix</td>
<td>MI2:St Croix</td>
<td>MI2:St Croix</td>
<td>MI2:St Croix</td>
</tr>
<tr>
<td>NV2:Marquette</td>
<td>NV2:Marquette</td>
<td>NV2:Marquette</td>
<td>NV2:Marquette</td>
<td>NV2:Marquette</td>
</tr>
<tr>
<td>SD1:Marquette</td>
<td>SD1:Marquette</td>
<td>SD1:Marquette</td>
<td>SD1:Marquette</td>
<td>SD1:Marquette</td>
</tr>
<tr>
<td>SD1:Frontenac</td>
<td>SD1:Frontenac</td>
<td>SD1:Frontenac</td>
<td>SD1:Frontenac</td>
<td>SD1:Frontenac</td>
</tr>
<tr>
<td>CT2:Marquette</td>
<td>CT2:Marquette</td>
<td>CT2:Marquette</td>
<td>CT2:Marquette</td>
<td>CT2:Marquette</td>
</tr>
<tr>
<td>CT2:St Croix</td>
<td>CT2:St Croix</td>
<td>CT2:St Croix</td>
<td>CT2:St Croix</td>
<td>CT2:St Croix</td>
</tr>
<tr>
<td>CT1:Frontenac</td>
<td>CT1:Frontenac</td>
<td>CT1:Frontenac</td>
<td>CT1:Frontenac</td>
<td>CT1:Frontenac</td>
</tr>
<tr>
<td>ND1:Frontenac</td>
<td>ND1:Frontenac</td>
<td>ND1:Frontenac</td>
<td>ND1:Frontenac</td>
<td>ND1:Frontenac</td>
</tr>
<tr>
<td>ND1:Marquette</td>
<td>ND1:Marquette</td>
<td>ND1:Marquette</td>
<td>ND1:Marquette</td>
<td>ND1:Marquette</td>
</tr>
<tr>
<td>ND1:St Croix</td>
<td>ND1:St Croix</td>
<td>ND1:St Croix</td>
<td>ND1:St Croix</td>
<td>ND1:St Croix</td>
</tr>
</tbody>
</table>

10 lb/vine  
30 nodes/vine  
30 shoots/vine  
1 shoot/node  
150 g/node
Challenge #2: Training Systems and Canopy Management

Costs vs Returns

Merlot
2-3 T/acre @ $1800/T

Intensive
Lower yields $$$

Cayuga White
7-8 T/acre @ $500/T

Minimal
Higher Yields $

Training Systems Trials in NY
*Marquette and Frontenac*

**Vertical Shoot Positioning (VSP):**
- Midwire cordon with catch wires
- Shoot position, shoot tip, leaf removal
  - *Intensive canopy management.*

**Top Wire Cordon (TWC):**
- High cordon
- ‘shoot combing’
  - *Moderate canopy management.*

**Umbrella Kniffen (UK):**
- 3-4 long canes arched and tied to middle wire.
- No additional canopy management
  - *Minimal canopy management.*
Marquette
2012 & 2013

**Yield**

<table>
<thead>
<tr>
<th>2012 Treatment</th>
<th>Yield (T/A)</th>
<th>Yield (lb/vine)</th>
<th>Clusters per vine</th>
<th>Cluster wt. (g)</th>
<th>Berries/cluster</th>
<th>Berry wt. (g)</th>
<th>Adj. # of shoots</th>
<th>Yield (g) per shoot (adj)</th>
<th>Clusters Per # shoot (adj)</th>
</tr>
</thead>
<tbody>
<tr>
<td>TWC</td>
<td>1.1 ab</td>
<td>3.4</td>
<td>23.6 b</td>
<td>63.5 a</td>
<td>48.8 a</td>
<td>1.3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VSP</td>
<td>1.0 b</td>
<td>3.2</td>
<td>26.7 ab</td>
<td>49.2 b</td>
<td>37.8 b</td>
<td>1.3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Umbrella</td>
<td>1.6 a</td>
<td>5.2</td>
<td>36.0 a</td>
<td>64.8 a</td>
<td>54.0 a</td>
<td>1.2</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>2013 Treatment</th>
<th>Yield (T/A)</th>
<th>Yield (lb/vine)</th>
<th>Clusters Per Vine</th>
<th>Cluster wt. (g)</th>
<th>Berries per cluster</th>
<th>Berry wt. (g)</th>
<th>Adj. # of shoots</th>
<th>Yield (g) per shoot (adj)</th>
<th>Clusters Per # shoot (adj)</th>
</tr>
</thead>
<tbody>
<tr>
<td>TWC</td>
<td>4.3 b</td>
<td>13.8</td>
<td>83.5 b</td>
<td>76.6 a</td>
<td>63.2 a</td>
<td>1.21 ab</td>
<td>36.9 b</td>
<td>178.1 a</td>
<td>2.3 a</td>
</tr>
<tr>
<td>VSP</td>
<td>2.3 c</td>
<td>7.4</td>
<td>69.4 c</td>
<td>49.2 b</td>
<td>43.4 b</td>
<td>1.13 b</td>
<td>36.3 b</td>
<td>94.2 b</td>
<td>1.9 b</td>
</tr>
<tr>
<td>Umbrella</td>
<td>5.0 a</td>
<td>16.1</td>
<td>101.3 a</td>
<td>72.5 a</td>
<td>59.2 a</td>
<td>1.23 a</td>
<td>41.0 a</td>
<td>178.8 a</td>
<td>2.5 a</td>
</tr>
</tbody>
</table>

@ $1500/ton = $3000 higher revenue/acre
Marquette
2014
Impact of Winter Injury

<table>
<thead>
<tr>
<th>Trtmt</th>
<th>Nodes per vine</th>
<th>Shoots per vine</th>
<th>Shoots per node</th>
<th>Clusters per shoot</th>
</tr>
</thead>
<tbody>
<tr>
<td>TWC</td>
<td>81.2</td>
<td>56.2</td>
<td>0.71</td>
<td>0.87</td>
</tr>
<tr>
<td>VSP</td>
<td>76.8</td>
<td>33.7</td>
<td>0.44</td>
<td>0.37</td>
</tr>
<tr>
<td>UK</td>
<td>81.2</td>
<td>46.1</td>
<td>0.57</td>
<td>0.93</td>
</tr>
</tbody>
</table>

Shoot Counts

Vine Collapse – Adjusted Yield

<table>
<thead>
<tr>
<th>Year</th>
<th>Treatment</th>
<th>Collapsed vines</th>
<th>No. Intact Vines</th>
<th>Yield lb/vine</th>
<th>Equivalent Yield t/acre</th>
<th>Adjusted Yield t/acre</th>
</tr>
</thead>
<tbody>
<tr>
<td>2014</td>
<td>TWC</td>
<td>13</td>
<td>15</td>
<td>9.93</td>
<td>3.4</td>
<td>1.8</td>
</tr>
<tr>
<td></td>
<td>VSP</td>
<td>3</td>
<td>24</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td></td>
<td>UK</td>
<td>11</td>
<td>17</td>
<td>7.76</td>
<td>2.7</td>
<td>1.6</td>
</tr>
</tbody>
</table>
Marquette Fruit Composition 2013

- **Marquette Brix**: Bar charts showing the change in Brix from 2012 to 2013 for Marquette, TWC, VSP, and Umbrella. Significant differences are indicated by lowercase letters.

- **Marquette pH**: Bar charts showing the change in pH from 2012 to 2013 for Marquette, TWC, VSP, and Umbrella. Significant differences are indicated by lowercase letters.

- **Marquette TA**: Bar charts showing the change in Titratable acidity (g/l) from 2012 to 2013 for Marquette, TWC, VSP, and Umbrella. Significant differences are indicated by lowercase letters.

- **Brix**: Line graphs showing the change in Brix from 8/19 to 9/26 for Marquette, TWC, VSP, and Umbrella. Significant differences are indicated by lowercase letters.

- **Marquette pH**: Line graphs showing the change in pH from 8/19 to 9/26 for Marquette, TWC, VSP, and Umbrella. Significant differences are indicated by lowercase letters.

- **Titratable Acidity**: Line graphs showing the change in Titratable acidity from 8/19 to 9/26 for Marquette, TWC, VSP, and Umbrella. Significant differences are indicated by lowercase letters.
Marquette Fruit Composition
2014
How does cropping level affect fruit composition?

Table 1. Yield components in Crop load Field Experiment from SWMREC in 2013.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Yield Tons/acre</th>
<th>Yield Kg/vine</th>
<th>Cluster/cluster</th>
<th>Cluster weight (g)</th>
<th>Berries / cluster</th>
<th>Avg. berry weight (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>13.81 a</td>
<td>18.17 a</td>
<td>264.0 a</td>
<td>114.85</td>
<td>93.00</td>
<td>1.19</td>
</tr>
<tr>
<td>Medium</td>
<td>9.84 b</td>
<td>12.95 b</td>
<td>184.8 b</td>
<td>115.61</td>
<td>94.34</td>
<td>1.18</td>
</tr>
<tr>
<td>Low</td>
<td>6.92 c</td>
<td>9.10 c</td>
<td>114.3 c</td>
<td>109.24</td>
<td>91.40</td>
<td>1.17</td>
</tr>
</tbody>
</table>

Table 2. Fruit chemical composition at harvest for Crop load Field Experiment from SWMREC in 2013.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>TSS (°Brix)</th>
<th>pH</th>
<th>TA (g/L)</th>
<th>Phenolics (a.u./g)</th>
<th>Anthocyanin (mol/g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>22.4 b</td>
<td>3.57 b</td>
<td>6.70</td>
<td>0.856</td>
<td>1.197</td>
</tr>
<tr>
<td>Medium</td>
<td>22.9 b</td>
<td>3.62 ab</td>
<td>6.93</td>
<td>0.818</td>
<td>1.129</td>
</tr>
<tr>
<td>Low</td>
<td>25.8 a</td>
<td>3.67 a</td>
<td>6.78</td>
<td>0.793</td>
<td>1.135</td>
</tr>
</tbody>
</table>
Exposed vs Shaded Clusters

*Impact on Brix, pH, TA*

- Measured fruit composition from individual sunlight-exposed and shaded clusters from the same vines
  - Frontenac 2013
  - Marquette 2014
  - Frontenac 2015
Shaded vs Exposed Clusters

*Frontenac 2013*

<table>
<thead>
<tr>
<th>Berry Weight</th>
<th>pH</th>
<th>Brix</th>
<th>TA</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Train</strong></td>
<td>Exposed</td>
<td>Shaded</td>
<td>Exposed</td>
</tr>
<tr>
<td><strong>TWC</strong></td>
<td>1.11</td>
<td>1.09</td>
<td>3.02</td>
</tr>
<tr>
<td><strong>UK</strong></td>
<td>1.05</td>
<td>1.06</td>
<td>3.00</td>
</tr>
<tr>
<td><strong>VSP</strong></td>
<td>1.07</td>
<td>1.09</td>
<td>3.12</td>
</tr>
</tbody>
</table>

![Berry Weight](image1.png)
![Brix](image2.png)
![pH](image3.png)
![Titratable Acidity](image4.png)
Shaded vs Exposed Clusters

Marquette 2014

- 6 vines
- 5 exposed and 5 shaded
- Individual Brix, pH, TA

<table>
<thead>
<tr>
<th></th>
<th>Exposed</th>
<th>Shaded</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brix</td>
<td>24.0</td>
<td>21.8</td>
</tr>
<tr>
<td>pH</td>
<td>3.25</td>
<td>3.28</td>
</tr>
<tr>
<td>Titratable Acidity (g/l)</td>
<td>11.0</td>
<td>9.5</td>
</tr>
</tbody>
</table>
Exposed vs Shaded Clusters

Marquette 2014
Shaded vs. Exposed Clusters

*Frontenac 2015*

- Brix:
  - Exposed: 22.2
  - Shaded: 20.5

- Titratable Acidity:
  - Exposed: 17.0
  - Shaded: 19.0

- Tartaric Acid (g/L):
  - Exposed: 6.5
  - Shaded: 5.5

- Malic Acid (g/L):
  - Exposed: 16
  - Shaded: 14
Preliminary Conclusions

• **(NY)** High training systems =
  – Higher yield
  – Lower cost
  – Minimal impact on fruit composition (Brix, pH, TA)

• **(MI)** Heavy cropping affected brix, not pH or TA
  – Caveat: Warm region, Heat units not limiting.

• **Within vines:**
  – Individual exposed clusters had higher soluble solids and lower titratable acidity than shaded clusters
Outreach to Industry

- Integration of Research and Extension
- Systems-based approach
- Develop growers/winemakers’ skills
Northern Grapes Symposium

- Held annually, in conjunction with another meeting
- Presentations by team members which update the audience about project findings

www.northerngrapesproject.org

2016 Michigan Grape & Wine Conference
February 24-26, 2016
Radisson Plaza Hotel, Kalamazoo
Northern Grapes News

- 4 issues each year
- Project news
- Team member profiles
- Relevant information
- Activities

www.northerngrapesproject.org
Northern Grapes Enterprise Workshops

- Held across the states involved in the project
- Include topics like barrel workshop, NE 1020 wine tasting, field days, etc.

www.northerngrapesproject.org
Northern Grapes Webinars

- 24 webinars thru Spring 2015
- 50-150 each broadcast
- Interactive
- Archived on NG website

www.northerngrapesproject.org
Upcoming Northern Grapes Webinars

- **March 8, 2016**
  “Cold-Hardy Grape Breeding at the University of Minnesota and North Dakota State University”
  Matt Clark, University of Minnesota and Harlene Hatterman-Valenti, North Dakota State University

- **April 12, 2016**
  “Northern Grapes Project Research Results: Fungicide Sensitivity and Vine Nutrition of Cold-Hardy Cultivars”
  Patricia McManus, University of Wisconsin-Madison and Carl Rosen, University of Minnesota

- **May 10, 2016**
  “From Vine to Glass: Understanding the Flavors and Aromas of Cold-Hardy Grapes and Wine”
  Anne Fennell, South Dakota State University; Adrian Hegeman University of Minnesota; and Somchai Rice, Iowa State University

[www.northerngrapesproject.org](http://www.northerngrapesproject.org)
User’s Manual

• Construction in 2015-16
• Digital format
• Research-based
• Specific to Cold Climate grape and wine industry
Brianna and La Crescent: Ten Viticulture Tips

John Thull and Jim Luby
University of Minnesota

Photo by Nicholas Howard

Photo by Dave Hansen
Univ. of Minnesota
Brianna

- Bred by Elmer Swenson, 1983
- Named by Ed Swanson, Cuthills Vineyard, NE in 2002
- Kay Gray x ES 2-12-13

Prairieberry.com
Brianna
Site Selection and Vineyard Establishment

- Vine spacing of 8' will fill the trellis, except in some low fertility, high pH soils.
- Vines fight upward growth. Do not use a VSP trellis system.

Ohio State Univ Bulletin 815

Cuthillswinery.com
Brianna
Training and Pruning

- Long, trailing shoots with stubborn tendrils.
- Long shoot internodes so leaf pulling not as critical as for La Crescent.
Brianna
Training and Pruning

- **Cluster weights** are typically under 1/4 pound.
  - Buds on node position 4 - 12 generally produce larger clusters
  - Very fruitful from secondary buds
Brianna
Training and Pruning

- Long cane renewal pruning with renewal spurs may work well for many areas.
  - Can tie 2 canes together in both directions to improve yields during cordon renewal.

- 5 to 8 buds per foot of trellis retained at pruning works well on healthy, mature vines.

Before Pruning

After Pruning
Brianna
Disease and Pest Management

• Clusters are susceptible to Downy Mildew.
  – Vine is highly sensitive to copper and moderately sensitive to sulfur.

Downy Mildew on leaf and Cluster
Copper damage

Photos by David S. Jones and Patricia McManus, University of Wisconsin
Brianna
Harvest Considerations

• **Berries plump up after veraison.** Compact clusters tend to split some berries inviting wasps and sour rots to take hold.

• **Harvest at around 14-16 Brix** to avoid over-development of unwanted foxy aromas.
  
  – usually late August to early September in Minnesota.
Brianna
Viticulture, Enology, and Wine tasting

Jim Luby and Murli R Dharmadhikari
NGP meeting Kalamazoo MI
2/24/16
Styles of Brianna

1. Crisp light bodied white: **crisp, lively, light in alcohol and not assertive in taste or aroma**
   Ex: Sauv. Blanc, Pinot Gris, Pinot Grigio, and Chenin Blanc

2. Smooth medium bodied white: **medium in body, flavor and acidity with a touch of sweetness in some cases**

3. Aromatic dry or off dry white: **fruity, perfumed, aromatic, floral medium bodied dry or off-dry**
   Ex: Riesling, Muscat, Gewurztraminer, Sauv. Blanc
Styles of Brianna, cont.

4. Barrel-fermented or partially barrel-fermented style: 
*increased aromatics, richness and mouth-feel*
Ex: Chardonnay

5. Sparkling: 100% pure or in a blend, either bulk-carbonated or “Methode Champenoise”: Sparkling wines are becoming more popular every day, low Brix at harvest lends itself to secondary in-the-bottle fermentation
Ex: Successful sparkling wines from L. Mawby (MI) and Illinois Sparkling Wine Co.
Brianna Aroma/Flavor Descriptors

• **Wine Quality and Characteristics:** ‘Brianna’ can be made into a semi-sweet white wine with pronounced pineapple nose and flavor when fully ripe.

• **For light table wines** with more grapefruit, tropical, and slight floral characteristics, ‘Brianna’ is best harvested between 3.2-3.4 pH.

• **Ed Swanson noted** that the grapes are high in pectin, and need extra enzymes for good juice yield. Whole-cluster pressing can help.

• **Acquaviva winery:** Sweet, medium body wine. Flavors are predominantly peaches, apricots, lime-candies, grapefruit, and pineapple. Ideal as a dessert wine.

• **Miletta Vista:** Brianna wine is filled with flavors of tropical fruits like pineapple, mango and kiwi. A great sipping wine for the sweeter palate.
Brianna Vinification

• **Harvest early based on pH.** Whole-cluster press with **rice hulls and pectinase enzyme** to boost clarification and juice yield

• **Settle well,** may use Bentolact-S addition to pre-fine/settle the juice

• **Ferment cool** with chosen yeast strain, 52F to 58F

• **Minimize oxygen exposure**

• **Clean racking and proper sulfiting** during processing/maturing, aim to inhibit Malo-Lactic (secondary) fermentation

• **Clarify, stabilize, filter, and bottle**
Whole-Cluster Processing
(...and you won’t need to clean your de-stemmer!)
The Wines

Frontenac Port

La Crescent

“does exhibit cherry and black currant flavors and aromas... but can be much more complex with integrated notes of blackberries, pepper, plum, tobacco, leather, and spice”.
Project Evaluation Survey

• Help us evaluate the Northern Grapes Project
• Followup to 2012 Survey
• Survey open from now through March 15
• https://umn.qualtrics.com/SE/?SID=SV_85JEKHqlD2Pk9zT
• Link Posted at http:northerngrapesproject.org
Acknowledgements

• Jim Luby, U MN
• Chrislyn Particka, Cornell University
  Project Manager
• Mike White
• Northern Grape Project Colleagues
  (States):
  – ND, SD, NE, MN, IA, WI, IL, MI, NY, VT, MA, CT
• Industry cooperators
  – 23 State winery and vineyard associations
  – 17 Vineyard, winery, marketing survey partners

• Funding: USDA and NYS Dept. Ag and Markets

The Northern Grapes Project is funded by the USDA's Specialty Crops Research Initiative Program of the National Institute for Food and Agriculture, Project #2011-51181-30850

Partnering Industry Associations

Connecticut Vineyard and Winery Association
Connecticut Farm Wine Development Council
Iowa Wine Growers Association
Western Iowa Wine Growers Association
Illinois Grape Growers and Vintners Association
Northern Illinois Wine Growers Scenic Rivers Grape and Wine Association
Massachusetts Farm Wineries and Growers Association
Michigan Grape and Wine Industry Council
Minnesota Farm Winery Association
Minnesota Grape Growers Association
Nebraska Winery and Grape Growers Association
New Hampshire Winery and Grape Growers Association
New York Wine and Grape Foundation
Upper Hudson Valley Wine and Grape Association
Lake Champlain Wines
Northern New York Wine Grape Growers Association
North Dakota Grape and Wine Association
Pennsylvania Winery Association
South Dakota Specialty Producers Association
South Dakota Winegrowers Association
Vermont Grape and Wine Industry Council
Wisconsin Grape Growers Association

Northern Grapes Project Team and Industry Advisory Council

Initiative Program of the National Institute for Food and Agriculture, Project #2011-51181-30850