Wine Grape Vineyard
Site Selection

Dr. Duke Elsner
Small Fruit Educator
Michigan State University Extension
Traverse City, Michigan
Thanks to

Dr. Ron Perry, MSU Department of Horticulture, East Lansing

and

Dr. Tom Zabadal, Southwest Michigan Research & Extension Center, Benton Harbor
Site selection is probably the most important decision a grower will make, especially in Michigan.

To establish a vineyard, one must consider three very important factors:

1. Climate
2. Topography
3. Soils
Climate

In winter, low temperatures can result in severe injury.

In late winter and early spring, injury can occur when fluctuating temperatures in late winter lead to deaclimation and early bud break.

Climate has a tremendous influence on aromatic characters and flavors in grape berries.
Climate

Climate is broken down into:

1. **Macroclimate** of the region; SW vs Northern Michigan, etc.

2. **Mesoclima**te of a local region; south facing slope of a hill or mountain range, end of the Old Mission Peninsula

3. **Microclimate**; the climate immediately around the vine canopy (hot humid summers can accelerate disease pressure).
The Great Lakes have a tremendous influence on the climate of our region.
Large bodies of water moderate temperature extremes
The Great Lakes moderate our climate to allow Michigan to grow 140,000 acres of fruit crops.
Macroclimate

Within Michigan, many sites have excellent potential to successfully grow grapes as long as there is an understanding as to what grape cultivars adapt best to the region.

Largely, it is resistance to low temperatures which limit cultivar selection for a specific site.
Mesoclimate

Regional landforms, differences in elevation, additional bodies of water, all contribute to variable mesoclimatic conditions in an area.
Mesoclimate

Regional landforms, differences in elevation, additional bodies of water, all contribute to variable mesoclimatic conditions in an area.
Average Number of Days with Temps Below -4F

Data and maps prepared by Aaron Pollyea, Peter Kurtz, and Tracy Aichele, Michigan Climatological Resources Program, Michigan State University Department of Geography, based on data from the NOAA, 1952-2001.

www.grapes.msu.edu/climate.htm
### Table 3. Vineyard site classifications for Michigan and their descriptions, based on winter minimum temperature data.

<table>
<thead>
<tr>
<th>Vineyard site classification</th>
<th>Classification description</th>
<th>Occurrence of -5°F (yrs/10 yrs)</th>
<th>Occurrence of -10°F (yrs/10 yrs)</th>
<th>Occurrence of -15°F (yrs/10 yrs)</th>
<th>Long-term winter minimum temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excellent</td>
<td>Suitable for cold-tender and hardier varieties, but cold-tender varieties may experience moderate or severe winter injury in 1 to 3 years and 1 year out of 10, respectively.</td>
<td>≤ 6</td>
<td>≤ 3</td>
<td>≤ 1</td>
<td>≥ -20°F</td>
</tr>
<tr>
<td>Good</td>
<td>Suitable for cold-tender and hardier varieties, but cold-tender varieties may experience moderate or severe winter injury in 1 to 4 years and 1 to 2 years out of 10, respectively.</td>
<td>≤ 9</td>
<td>≤ 4</td>
<td>≤ 2</td>
<td>≥ -24°F</td>
</tr>
<tr>
<td>Acceptable</td>
<td>Suitable for moderate or hardier varieties. These vines may experience moderate or severe winter injury in 1 to 3 years and 1 year out of 10, respectively.</td>
<td>≤ 10</td>
<td>≤ 6</td>
<td>≤ 3</td>
<td>≥ -24°F</td>
</tr>
<tr>
<td>Unacceptable</td>
<td>Not suitable for sustained, commercial production of any varieties.</td>
<td>≤ 10</td>
<td>≤ 8</td>
<td>≥ 4</td>
<td>≤ -25°F</td>
</tr>
</tbody>
</table>
Michigan regions suitable for vinifera cultivars (still with some risk)
Table 3. Vineyard site classifications for Michigan and their descriptions, based on winter minimum temperature data.

<table>
<thead>
<tr>
<th>Vineyard site classification</th>
<th>Classification description</th>
<th>Occurrence of -5°F (yrs/10 yrs)</th>
<th>Occurrence of -10°F (yrs/10 yrs)</th>
<th>Occurrence of -15°F (yrs/10 yrs)</th>
<th>Long-term winter minimum temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excellent</td>
<td>Suitable for cold-tender and hardier varieties, but cold-tender varieties may experience moderate or severe winter injury in 1 to 3 years and 1 year out of 10, respectively.</td>
<td>≤ 6</td>
<td>≤ 3</td>
<td>≤ 1</td>
<td>≥ -20°F</td>
</tr>
<tr>
<td>Good</td>
<td>Suitable for cold-tender and hardier varieties, but cold-tender varieties may experience moderate or severe winter injury in 1 to 4 years and 1 to 2 years out of 10, respectively.</td>
<td>≤ 9</td>
<td>≤ 4</td>
<td>≤ 2</td>
<td>≥ -24°F</td>
</tr>
<tr>
<td>Acceptable</td>
<td>Suitable for moderate or hardier varieties. These vines may experience moderate or severe winter injury in 1 to 3 years and 1 year out of 10, respectively.</td>
<td>≤ 10</td>
<td>≤ 6</td>
<td>≤ 3</td>
<td>≥ -24°F</td>
</tr>
</tbody>
</table>

Super cold hardy varieties

≤ 10 ≤ 8 ≥ 4 ≤ -25°F
Mean Length of Growing Season

Average Length of Growing Season (days)

- <135 (not suitable)
- 135-165 (check site)
- 165-195 (suitable)
Growing Degree-Days (GDD)

- Used in New World grape growing to assess impact of growing season temperatures on wine quality.

- A daily measure of heat that is physiologically useful to a grapevine. Typically calculated as the average temperature of the day above 50 F.


- Typically starting April 1, accumulated to Oct 31.
Growing Degree-Days (GDD)

- Example calculation for a day that had a high of 80°F and a low of 60°F.

\[
GDD = \left(\frac{80 + 60}{2}\right) - 50
\]

\[
= 70 - 50
\]

\[
= 20 \text{ degree days}
\]
Growing Degree-Days (GDD)

Example calculation for a day that had a high of 60 F and a low of 40 F.

\[
\text{GDD} = \left(\frac{60 + 40}{2}\right) - 50
\]

\[
= 50 - 50
\]

\[
= 0 \text{ degree days}
\]
Examples of seasonal degree day accumulation in high latitude vine growing districts.

(Adapted from website information provided by R. M. Pool)... T. Zabadal

<table>
<thead>
<tr>
<th>Location</th>
<th>Latitude</th>
<th>Seasonal Degree Day Accumulation (50°F base)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reims, France (Champagne)</td>
<td>49° 20'</td>
<td>1,756</td>
</tr>
<tr>
<td>Dijon, France (Burgundy)</td>
<td>47° 15'</td>
<td>2,084</td>
</tr>
<tr>
<td>Bordeaux, France</td>
<td>44° 50'</td>
<td>2,464</td>
</tr>
<tr>
<td>Canberra, Australia</td>
<td>36°</td>
<td>2,714</td>
</tr>
<tr>
<td>Bolzano, Italy</td>
<td>46° 30'</td>
<td>2,985</td>
</tr>
<tr>
<td>St. Helena, California</td>
<td>38° 30'</td>
<td>3,302</td>
</tr>
<tr>
<td>Fresno, California</td>
<td>36° 40'</td>
<td>4,684</td>
</tr>
<tr>
<td>Watervliet, Michigan (2005)</td>
<td>42° 08'</td>
<td>3,210</td>
</tr>
</tbody>
</table>
Average Growing Degree Days

Average Number of Growing Degree Days In Frost-Free Season

- <1800 (not suitable)
- 1800 - 2500
- 2500 - 3100
Influence of the ripening month mean temperature average on wine quality. (Adapted from Viticulture and Environment by J. Gladstones)… T. Zabadal.

<table>
<thead>
<tr>
<th>Mean ripening month temperature</th>
<th>less than 59° F</th>
<th>59 to 70 °F</th>
<th>greater than 70 °F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wine quality</td>
<td>inferior</td>
<td><strong>optimum</strong></td>
<td>inferior</td>
</tr>
<tr>
<td>Fruit characteristics</td>
<td>High acid</td>
<td>Sugar/acid  balanced</td>
<td>High sugar Low acid</td>
</tr>
<tr>
<td></td>
<td>Questionable ripeness</td>
<td>Good fruit character</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Low sugar</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Wine quality:
- Inferior: High sugar/acid imbalanced, questionable ripeness, low sugar.
- Optimum: Sugar/acid balanced, good fruit character.
- Inferior: High sugar, low acid.
Mean monthly temperature from 1951 to 1980
(From The Climatic Atlas of Michigan by Eichenlaub et al., 1990)... T. Zabadal
Mean monthly temperature from 1951 to 1980

(From The Climatic Atlas of Michigan by Eichenlaub et al., 1990)... T. Zabadal
Topography
Local Topography
Influences of Slope on vineyards

- South to southwest facing slopes provide best degree day accumulation and fall ripening conditions
- Slopes provide for movement of cold air out of vineyards
- Slope suitability limited by only by ability to manage the site
- Terraced vineyards are possible
Solar radiation is influenced by slope and aspect for sites in cool climates


Figure 5.5 Reception of direct sunlight in relation to position and inclination of slope (48°15′N) in the upper Rhine Valley (from Becker, 1985b, reproduced by permission).
Cold Air Sinks and Flows Downhill

- Very important during spring and fall frosts
Cold Air Sinks and Flows Downhill

- Very important during spring and fall frosts
Cold Air Sinks and Flows Downhill

- Very important during spring and fall frosts

hedges or woods upslope from vineyard block cold air from entering a vineyard

low area or "frost pocket" not suitable for a vineyard site

cold air current
Fig. III-3. A schematic to show the zones of temperature created on a slope as a result of katabatic winds, thermal inversion and adiabatic cooling.
Fig. V-3. The minimum temperature at 60 inches above the ground at six locations along a slope in a small valley in southwestern Michigan in the winters of 2004-05 and 2005-06.
Topography and snow accumulation -

• Snow is a very effective insulator from cold
Topography and snow accumulation
- Snow cover can protect lower buds
Topography and planting patterns
Degree of slope should not exceed 7-9 %, to avoid problems with equipment used for ground floor maintenance, pruning, harvest, etc.
Soils

- Grapes need well drained soil.

- Traditionally, preference is to soils which yields balance in supporting crop and canopy.

- The term *Terroir* is of French derivation and is a complex interaction among soil, climate, biology and human intervention. The special character or personality of a wine may be confined to just one small block. New world grape production is less confined and restricted to *Terroir*. Many scientists point to no empirical data to support European claims.
Soil Limitations

- Grapes tolerate a wide range of soil textures
- Grapes tolerate a wide range of pH
- Potassium & Magnesium needs
- Good drainage is critical – no “wet feet”
- Grapes are deep-rooted but most feeder roots are within two feet of the soil surface
- Trellis problems in shallow soils
Rootstocks can help alleviate soil maladies such as lime induced chlorosis, Phyloxera, nematodes, drought, wet soils and Armillaria
Very good review of rootstocks and their usage
Key factors to consider for the best sites for vineyards for wine production in Michigan

- Longer, warmer growing season areas are a high priority.

- If possible, be near Lake Michigan which moderates the micro and meso climate, especially as it relates to low temperature episodes.

- The site should be sloping with best sites having a southern exposure.

- Best sites have well drained soils.

- Michigan has a long history of growing fruit, confine consideration to areas where fruit has been grown commercially.
Site selection and your business model

Potential sites for wine grape production in Michigan must include consideration for the type of business interest...

- Vineyard established for fruit to sell to wineries – seek best growing sites.

- Vineyard established to support an on site winery -- best sites, but....

- Vineyard established to support an on site winery, primarily influenced by traffic/customer travel -- site influenced by commerce.

- Vineyard (small) established to provide an ambience to tasting room -- site established as part of landscape.
Site selection and your business model
Cultivar / Site Selection Tradeoffs

Following list of cultivar groups are ranked in order of market/consumer interest and are in inverse order of cold tolerance:

1. **Vinifera Cultivars;** Chardonnay, Riesling, etc. (Limited to areas above -4 degrees F. Mean low temp = Best Sites).

2. **French Hybrids;** Older cultivars developed in France using species native to America which were crossed with Vinifera cultivars to increase cold tolerance and resistance to pests (Vidal, Seyval, Chamboucin, Foch, etc). Contemporary breeding programs exist in America (NYAES, Geneva) and in Europe, with this goal in mind (Cayuga White, Carot Noir, etc). (Limited to Fruit production areas)
Cultivar / Site Selection Tradeoffs

Following list of cultivar groups are ranked in order of market/consumer interest and are in inverse order of cold tolerance:

3. **American Hybrids**; beginning with the breeder, T.V. Munson, there were many varieties developed such as Cynthiana, Norton, Delaware, Niagara and Concord used for wine and juice production. *(Limited to Fruit production areas).*

4. **Super Cold Hardy Hybrids** such as Frontenac, Marquette, St. Croix, LaCrescent, etc. *(Suitable for many areas in Michigan).*
References


