Vineyard Site Considerations

Vineyard Site Selection for Maryland’s Diverse Regions

Joseph A. Fiola, Ph.D.
Specialist in Viticulture and Small Fruit
University of Maryland Extension
Vineyard Site Considerations

“The Wine is made in the Vineyard”
Grape Varieties

“The Wine is made in the Vineyard”

“Ripe grapes”
Vineyard Site Considerations

Location, Location, Location…

“The quickest way to get into quality grape production ….is the slow way!”
Vineyard Site Considerations

Terroir

“Creating a wine that represents the soil and climate where it is grown and the hands of person who made it.”
Vineyard Site Considerations

Primary Consideration

Frequency of low temperature extremes inducing crop/vine damage
— e.g., occurrence of -5 or -10 F

Note: Low temperature damage is the number one limiting factor to consistent grape production in the Eastern US.
Note: Excess water may be the number one limiting factor to consistent quality grape production in the Eastern US.

Contributes to
- winter damage
- excess vegetative vigor
- reduced quality during ripening
Vineyard Site Considerations

Site Considerations

- Climate
- Topography
- Soil
- Proximity to Vineyard Pests
- Logistics
Vineyard Site Considerations

Climate

• **Macro-climate - region**
  - minimum winter temperatures
  - summer temperatures and humidity

• **Meso-climate – specific location**
  - slope
  - moderating effect of body of water

• **Micro-climate – specific area**
  - area inside canopy or around a cluster
Vineyard Site Considerations

Macro-Climate considerations

• Length of growing season
  – 165 days generally considered as minimum
  – 180 or more days for long-season varieties

• Frequency of low temperature extremes
  – e.g., occurrence of -5 or -10 F

• Frequency of drought or excessive rains
  – need for irrigation
Vineyard Site Considerations

Macro-Climate considerations

[Map of Maryland showing different regions such as Western Mountain, Piedmont Plateau, Baltimore, Southern Plain, Eastern Shore, and Chesapeake Bay.]
<table>
<thead>
<tr>
<th>STATION</th>
<th>MEAN DAILY TEMP IN JULY</th>
<th>RECORD LOW</th>
<th>DAYS OVER 90</th>
<th>FFP*</th>
<th>GDD**</th>
<th>UCD***</th>
<th>MTWM****</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abedeen</td>
<td>87 66</td>
<td>-12</td>
<td>19</td>
<td>200</td>
<td>3,640</td>
<td>IV</td>
<td>Very Hot</td>
</tr>
<tr>
<td>Annapolis</td>
<td>88 68</td>
<td>-8</td>
<td>32</td>
<td>204</td>
<td>3,700</td>
<td>IV</td>
<td>Very Hot</td>
</tr>
<tr>
<td>BWI Airport</td>
<td>87 67</td>
<td>-7</td>
<td>31</td>
<td>200</td>
<td>3,640</td>
<td>IV</td>
<td>Very Hot</td>
</tr>
<tr>
<td>Beltsville</td>
<td>87 64</td>
<td>-15</td>
<td>28</td>
<td>176</td>
<td>3,625</td>
<td>IV</td>
<td>Very Hot</td>
</tr>
<tr>
<td>Chestertown</td>
<td>87 67</td>
<td>-7</td>
<td>30</td>
<td>209</td>
<td>3,630</td>
<td>IV</td>
<td>Very Hot</td>
</tr>
<tr>
<td>Conowingo Dam</td>
<td>86 64</td>
<td>-10</td>
<td>24</td>
<td>199</td>
<td>3,500</td>
<td>III</td>
<td>Very Hot</td>
</tr>
<tr>
<td>Cumberland</td>
<td>88 63</td>
<td>-14</td>
<td>33</td>
<td>178</td>
<td>2,800</td>
<td>II</td>
<td>Very Hot</td>
</tr>
<tr>
<td>Denton</td>
<td>88 65</td>
<td>-11</td>
<td>37</td>
<td>187</td>
<td>3,650</td>
<td>IV</td>
<td>Very Hot</td>
</tr>
<tr>
<td>Emmitsburg</td>
<td>86 62</td>
<td>-27</td>
<td>21</td>
<td>162</td>
<td>3,250</td>
<td>III</td>
<td>Very Hot</td>
</tr>
<tr>
<td>Hagerstown</td>
<td>86 64</td>
<td>-17</td>
<td>25</td>
<td>187</td>
<td>3,200</td>
<td>III</td>
<td>Very Hot</td>
</tr>
<tr>
<td>La Plata</td>
<td>86 66</td>
<td>-8</td>
<td>24</td>
<td>188</td>
<td>3,700</td>
<td>IV</td>
<td>Very Hot</td>
</tr>
<tr>
<td>Mechanicsville</td>
<td>87 65</td>
<td>-9</td>
<td>24</td>
<td>199</td>
<td>3,740</td>
<td>IV</td>
<td>Very Hot</td>
</tr>
<tr>
<td>Oakland</td>
<td>79 56</td>
<td>-27</td>
<td>2</td>
<td>128</td>
<td>2,400</td>
<td>I</td>
<td>Warm</td>
</tr>
<tr>
<td>Owings Ferry</td>
<td>87 66</td>
<td>-8</td>
<td>26</td>
<td>200</td>
<td>3,700</td>
<td>IV</td>
<td>Very Hot</td>
</tr>
<tr>
<td>Parkton</td>
<td>84 62</td>
<td>-12</td>
<td>12</td>
<td>170</td>
<td>3,470</td>
<td>III</td>
<td>Hot</td>
</tr>
<tr>
<td>Rockville</td>
<td>86 64</td>
<td>-13</td>
<td>25</td>
<td>190</td>
<td>3,590</td>
<td>IV</td>
<td>Very Hot</td>
</tr>
<tr>
<td>Royal Oak</td>
<td>87 68</td>
<td>-6</td>
<td>26</td>
<td>215</td>
<td>3,700</td>
<td>IV</td>
<td>Very Hot</td>
</tr>
<tr>
<td>Salisbury</td>
<td>86 67</td>
<td>-8</td>
<td>25</td>
<td>196</td>
<td>3,690</td>
<td>IV</td>
<td>Very Hot</td>
</tr>
<tr>
<td>Unionville</td>
<td>85 61</td>
<td>-22</td>
<td>22</td>
<td>152</td>
<td>3,330</td>
<td>III</td>
<td>Hot</td>
</tr>
<tr>
<td>Woodstock</td>
<td>87 64</td>
<td>-18</td>
<td>27</td>
<td>172</td>
<td>3,500</td>
<td>III</td>
<td>Very Hot</td>
</tr>
</tbody>
</table>

* Average Frost-Free Period
** Medium Growing Degree Days April-October (50 degree F base)
*** Grape region classification number based on UC Davis classification system (Winkler et al, 1974)
**** Mean Temperature of the Warmest Month (July) classification system of grape growing regions (Smart and Dry, 1980)
<table>
<thead>
<tr>
<th>STATION</th>
<th>MEAN DAILY TEMP IN JULY</th>
<th>RECORD LOW</th>
<th>DAYS OVER 90</th>
<th>FFP*</th>
<th>GDD**</th>
<th>UCD***</th>
<th>MTWM****</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Max - Min</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Abedeen</td>
<td>87 66</td>
<td>-12</td>
<td>19</td>
<td>200</td>
<td>3,640</td>
<td>IV</td>
<td>Very Hot</td>
</tr>
<tr>
<td>Annapolis</td>
<td>88 68</td>
<td>-8</td>
<td>32</td>
<td>204</td>
<td>3,700</td>
<td>IV</td>
<td>Very Hot</td>
</tr>
<tr>
<td>BWI Airport</td>
<td>87 67</td>
<td>-7</td>
<td>31</td>
<td>200</td>
<td>3,640</td>
<td>IV</td>
<td>Very Hot</td>
</tr>
<tr>
<td>Beltsville</td>
<td>87 64</td>
<td>-15</td>
<td>28</td>
<td>176</td>
<td>3,625</td>
<td>IV</td>
<td>Very Hot</td>
</tr>
<tr>
<td>Chestertown</td>
<td>87 67</td>
<td>-7</td>
<td>30</td>
<td>209</td>
<td>3,630</td>
<td>IV</td>
<td>Very Hot</td>
</tr>
<tr>
<td>Conowingo Dam</td>
<td>86 64</td>
<td>-10</td>
<td>24</td>
<td>199</td>
<td>3,500</td>
<td>III</td>
<td>Very Hot</td>
</tr>
<tr>
<td>Cumberland</td>
<td>88 63</td>
<td>-14</td>
<td>33</td>
<td>178</td>
<td>2,800</td>
<td>II</td>
<td>Very Hot</td>
</tr>
<tr>
<td>Denton</td>
<td>88 65</td>
<td>-11</td>
<td>37</td>
<td>187</td>
<td>3,650</td>
<td>IV</td>
<td>Very Hot</td>
</tr>
<tr>
<td>Emmitsburg</td>
<td>86 62</td>
<td>-27</td>
<td>21</td>
<td>162</td>
<td>3,250</td>
<td>III</td>
<td>Very Hot</td>
</tr>
<tr>
<td>Hagerstown</td>
<td>86 64</td>
<td>-17</td>
<td>25</td>
<td>187</td>
<td>3,200</td>
<td>III</td>
<td>Very Hot</td>
</tr>
<tr>
<td>La Plata</td>
<td>86 66</td>
<td>-8</td>
<td>24</td>
<td>188</td>
<td>3,700</td>
<td>IV</td>
<td>Very Hot</td>
</tr>
<tr>
<td>Mechanicsville</td>
<td>87 65</td>
<td>-9</td>
<td>24</td>
<td>199</td>
<td>3,740</td>
<td>IV</td>
<td>Very Hot</td>
</tr>
<tr>
<td>Oakland</td>
<td>79 56</td>
<td>-27</td>
<td>2</td>
<td>128</td>
<td>2,400</td>
<td>I</td>
<td>Warm</td>
</tr>
<tr>
<td>Owings Ferry</td>
<td>87 66</td>
<td>-8</td>
<td>26</td>
<td>200</td>
<td>3,700</td>
<td>IV</td>
<td>Very Hot</td>
</tr>
<tr>
<td>Parkton</td>
<td>84 62</td>
<td>-12</td>
<td>12</td>
<td>170</td>
<td>3,470</td>
<td>III</td>
<td>Hot</td>
</tr>
<tr>
<td>Rockville</td>
<td>86 64</td>
<td>-13</td>
<td>25</td>
<td>190</td>
<td>3,590</td>
<td>IV</td>
<td>Very Hot</td>
</tr>
<tr>
<td>Royal Oak</td>
<td>87 68</td>
<td>-6</td>
<td>26</td>
<td>215</td>
<td>3,700</td>
<td>IV</td>
<td>Very Hot</td>
</tr>
<tr>
<td>Salisbury</td>
<td>86 67</td>
<td>-8</td>
<td>25</td>
<td>196</td>
<td>3,690</td>
<td>IV</td>
<td>Very Hot</td>
</tr>
<tr>
<td>Unionville</td>
<td>85 61</td>
<td>-22</td>
<td>22</td>
<td>152</td>
<td>3,330</td>
<td>III</td>
<td>Hot</td>
</tr>
<tr>
<td>Woodstock</td>
<td>87 64</td>
<td>-18</td>
<td>27</td>
<td>172</td>
<td>3,500</td>
<td>III</td>
<td>Very Hot</td>
</tr>
</tbody>
</table>

* Average Frost-Free Period  ** Medium Growing Degree Days April-October (50 degree F base)
*** Grape region classification number based on UC Davis classification system (Winkler et al, 1974)
**** Mean Temperature of the Warmest Month (July) classification system of grape growing regions (Smart and Dry, 1980)
Vineyard Site Considerations

Cold Hardiness

- **Fall Acclimation**
  - hardening of canes

- **Minimum Temperature Tolerance**
  - single/multiple events

- **Fluctuating Temperature Tolerance**
  - diurnal large diurnal swings

- **Deacclimation**
  - re-acclimation – depends on stage

- **Late Frosts**
Vineyard Site Considerations

Climate

• **Macro-climate - region**
  - minimum winter temperatures
  - summer temperatures and humidity

• **Meso-climate – specific location**
  - slope
  - moderating effect of body of water

• **Micro-climate – specific area**
  - area inside canopy or around a cluster
Growing Degree Days - Maryland

Growing Degree Days

- < 2500
- 2500 - 2600
- 2600 - 2700
- 2700 - 2800
- 2800 - 2900
- 2900 - 3000
- 3000 - 3100
- 3100 - 3200
- 3200 - 3300
- 3300 - 3400
- 3400 - 3500
- 3500 - 3600
- 3600 - 3700
- 3700 - 3800

0 30 60 90 120 Miles

North
South
West
East
Vineyard Site Considerations
Vineyard Site Considerations

Climate

- **Macro-climate - region**
  - minimum winter temperatures
  - summer temperatures and humidity

- **Meso-climate – specific location**
  - slope
  - moderating effect of body of water

- **Micro-climate – specific area**
  - area inside canopy or around a cluster

- **Precipitation**
  - amount and timing
Vineyard Site Considerations

moderating effect of significant body of water
Vineyard Site Considerations

Site Considerations

- Climate
- **Topography**
- Soil
- Proximity to Vineyard Pests
- Logistics
Vineyard Site Considerations

Topography

- Degree of Slope
  - air movement
  - water movement

- Aspect of Slope
  - N, S, E, W+
Vineyard Site Considerations
Vineyard Site Considerations

Topography

- Elevation is the single most important vineyard feature in the mid-Atlantic region
  - impacts frequency of low temperature extremes
  - impacts length of growing season

We attempt to minimize risks;
Elimination of risk is not realistic.
Vineyard Site Considerations

Topography and Air Movement
Vineyard Site Considerations
Topography and Air Movement
Vineyard Site Considerations

Topography

• Degree of Slope
  ▪ air movement
  ▪ water movement

• Aspect of Slope
  ▪ N, S, E, W+
## Vineyard Site Considerations

### Aspect/Vine Phenology

<table>
<thead>
<tr>
<th>Phenological Character</th>
<th>North</th>
<th>South</th>
<th>East</th>
<th>West</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spring bud break</td>
<td>Retard</td>
<td>Advance</td>
<td>Retard</td>
<td>Advance</td>
</tr>
<tr>
<td>Maximum temperature</td>
<td>Less</td>
<td>Greater</td>
<td>Less</td>
<td>Greater</td>
</tr>
<tr>
<td>A.M. foliage drying</td>
<td>-</td>
<td>-</td>
<td>Rapid</td>
<td>Slow</td>
</tr>
<tr>
<td>Radiant heat of fruit</td>
<td>Less</td>
<td>Greater</td>
<td>Less</td>
<td>Greater</td>
</tr>
<tr>
<td>Radiant heat of vine</td>
<td>Less</td>
<td>Greater</td>
<td>Less</td>
<td>Greater</td>
</tr>
</tbody>
</table>
Vineyard Site Considerations

Frost Mitigation
Vineyard Site Considerations

Site Considerations

- Climate
- Topography
- **Soil**
- Proximity to Vineyard Pests
- Logistics
Vineyard Site Considerations

**Soils**

**Type (desirable characteristics)**

- **Well to excessively well drained**
  - No hard pan
  - Adequate aeration
  - Adequate depth to groundwater/SWT

- **Medium to low water holding capacity**
  - Sand/clay ratio
  - Organic matter content
  - pH

- **Adequate depth**
  - Grapes deep rooted
  - Avoid drought
  - Adequate depth to groundwater
  - Saltwater intrusion
Vineyard Site Considerations
Vineyard Site Considerations

Soils

NRCS – Soil Conservation Service

- NRCS County Office
  - Hard copy
  - A Person with knowledge and experience in your region

- Web Based

http://websoilsurvey.nrcs.usda.gov/app/

- Search by address
- Area of interest
- Soil types and descriptions
Queen Anne's County, Maryland

**MtA**—Mattapex-Butlertown silt loams, 0 to 2 percent slopes

**Map Unit Setting**
- **Elevation:** 0 to 120 feet
- **Mean annual precipitation:** 38 to 48 inches
- **Mean annual air temperature:** 52 to 57 degrees F
- **Frost-free period:** 190 to 235 days

**Map Unit Composition**
- Mattapex and similar soils: 45 percent
- Butlertown and similar soils: 30 percent
- Minor components: 25 percent

**Description of Mattapex**

**Properties and qualities**
- **Slope:** 0 to 2 percent
- **Depth to restrictive feature:** More than 80 inches
- **Drainage class:** Moderately well drained
- **Capacity of the most limiting layer to transmit water (Ksat):**
  - Moderately high to high (0.20 to 1.98 in/hr)
- **Depth to water table:** About 18 to 36 inches
- **Frequency of flooding:** None
- **Frequency of ponding:** None
- **Available water capacity:** Very low (about 2.8 inches)
**Vineyard Site Considerations**

**WSS - Soil Evaluation**

**Queen Anne's County, Maryland (MD035)**

<table>
<thead>
<tr>
<th>Map Unit Symbol</th>
<th>Map Unit Name</th>
<th>Acres in AOI</th>
<th>Percent of AOI</th>
</tr>
</thead>
<tbody>
<tr>
<td>IgB</td>
<td>Ingleside sandy loam, 2 to 5 percent slopes</td>
<td>0.4</td>
<td>13.5%</td>
</tr>
<tr>
<td>MtA</td>
<td>Mattapex-Butlertown silt loams, 0 to 2 percent slopes</td>
<td>2.0</td>
<td>66.2%</td>
</tr>
<tr>
<td>PIA</td>
<td>Pineyneck silt loam, 0 to 2 percent slopes</td>
<td>0.2</td>
<td>7.3%</td>
</tr>
<tr>
<td>UaB</td>
<td>Union Speekeans</td>
<td>0.4</td>
<td>12.5%</td>
</tr>
</tbody>
</table>

**Queen Anne's County, Maryland**

**IgB—Ingleside sandy loam, 2 to 5 percent slopes**

**Map Unit Setting**

- **Elevation:** 10 to 120 feet
- **Mean annual precipitation:** 40 to 48 inches
- **Mean annual air temperature:** 50 to 57 degrees F
- **Frost-free period:** 180 to 235 days

**Map Unit Composition**

- **Ingleside and similar soils:** 60 percent
- **Minor components:** 40 percent

**Description of Ingleside**

**Properties and qualities**

- **Slope:** 2 to 5 percent
- **Depth to restrictive feature:** More than 80 inches
- **Drainage class:** Well drained
- **Capacity of the most limiting layer to transmit water (Ksat):**
  - Moderately high to high (0.60 to 5.95 in/hr)
- **Depth to water table:** About 42 to 72 inches
- **Frequency of flooding:** None
- **Frequency of ponding:** None
- **Available water capacity:** Very low (about 1.3 inches)
Vineyard Site Considerations

On-site Investigations

- Soil Pits
  - Rooting depth
  - Soil texture throughout profile
  - Potential problem areas
    - mottling

- Augured Holes
  - Spring - test drainage
  - Indicate need for tiling

- Shovel!
Vineyard Site Considerations

Water Management – Site Remediation

Deep rip to augment water drainage
Vineyard Site Considerations

“Wet feet”

Increased winter cold damage susceptibility
Vineyard Site Considerations

Irrigation
Critical for establishment and maintenance on well drained soils
Vineyard Site Considerations

GIS/GPS Mapping of MD Counties

UME and MDP

- Web Based
  - Maryland State summary
    http://www.grapesandfruit.umd.edu/Grapes/Presentations/SiteSuitabilityMaryland122007.pdf
  - Northern tier Counties – Washington
    http://www.grapesandfruit.umd.edu/Grapes/Presentations/SiteSuitabilityWashCo122007.pdf
  
- Print hard copy
- On line power point presentation
Vineyard Site Considerations

Relative Suitability Ratings for Map Components

- Elevation: 30 points
- Soils: 25 points
- Land use/Zoning: 20 points
- Slope: 15 points
- Aspect: 10 points

Total: 100 points
Washington County, MD

Suitability Maps

Elevation

Land Use

Soils

Slope

Aspect
Vineyard Site Considerations

Composite Suitability Map – Washington County, MD

SUITABILITY FOR VITICULTURE IN WASHINGTON COUNTY, MD

- 1 to 19
- 20 to 29
- 30 to 39
- 40 to 49
- 50 to 100

Suitability ranking developed thus far using slope, aspect, elevation and land use characteristics.

Soils best suited to vineyards still under development.
Vineyard Site Considerations

GIS/GPS Mapping of Site Suitability

http://www.grapesandfruit.umd.edu/Grapes/Presentations/SiteSuitabilityMaryland122007.pdf

Areas Suitable for Grape Growing and Wine Making in Maryland

VINEYARD SUITABILITY SCORE
- NOT SUITED - Score 0 to 20
- POOR LOCATIONS - Score 21 to 40
- FAIR LOCATIONS - Score 41 to 60
- GOOD LOCATIONS - Score 61 to 80
- BEST LOCATIONS - Score 81 to 100

The Vineyard Suitability Model uses a weighted score for soil, slope, aspect, elevation, and land use/land cover to identify the best locations for vineyards in Maryland.

May 2, 2005
Vineyard Site Considerations

GIS/GPS Mapping of Site Suitability

Peter Sforza, Virginia Tech; http://training.gis.vt.edu/EastCoastViticulture/webcontent/flexviewer2.
Vineyard Site Considerations

GIS/GPS Mapping of Site Suitability

Peter Sforza, Virginia Tech; http://training.gis.vt.edu/EastCoastViticulture/webcontent/flexviewer2.
Vineyard Site Considerations

Prioritization of physical features in site selection
Climate considered separately

- Relative elevation
- Absolute elevation
- Soil hydrology (internal and surface drainage)
- Land use (forest vs. pasture; rockiness)
- Proximity to sensitive areas (e.g., schools)
- Proximity to biotic and abiotic hazards
- Other soil features (depth, OM, pH, etc.)
- Slope
- Aspect

Peter Sforza, Virginia Tech; http://training.gis.vt.edu/EastCoastViticulture/webcontent/flexviewer2.
Vineyard Site Considerations

Site Considerations

- Climate
- Topography
- Soil
- Proximity to Vineyard Pests
  - Neighbors!
- Logistics
Vineyard Site Considerations

2,4-D Damage

New MDA Sensitive Crop Locator!

http://www.marylandgrapes.org/growing/SensitiveCropProgram.shtml
Vineyard Site Considerations

Logistics - Proximity
Vineyard Site Considerations

Take Home/Conclusions

- Site selection should consider the hazards at the macro- as well as meso-scale level.
- Elevation is the single most important vineyard feature in the mid-Atlantic region -- impacts length of growing season and frequency of low temperature extremes.
- Soil hydrology is perhaps the most important feature of soil (prefer very well drained soil)
- We attempt to minimize risks; elimination of risk is not realistic.