Soil Selection Factors

- Internal Drainage Characteristic
  Most important
  Roots need aeration to function
- Moisture Holding Capacity
  Texture
  Depth
- pH
- Fertility
Chances of Success are Limited
Under Conditions of Poor Soil Drainage
Reasons for Poor Soil Drainage

- Poor surface runoff
  - Slope
  - Depressions
- Lateral seepage
  - On slopes
- Texture
  - High clay content
- Impervious layer in substrata
  - Clay layer
  - Compacted layer
  - Abrupt textural change
- High water table
Soil Information is Available in County Soil Survey

- Soil Series Description:
  Texture, Drainage, Fertility, Erosion

- Soil Profile Classification:
  Structure

- Table of Engineering Index Properties:
  Soil texture classification by depth

- Table of Physical & Chemical Properties:
  Permeability, Available water holding capacity, Organic matter content
<table>
<thead>
<tr>
<th>Classification</th>
<th>AVOID</th>
<th>Avoid</th>
<th>Marginal</th>
<th>Suitable</th>
<th>Ideal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very poorly drained</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Poorly drained</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Somewhat poorly drained</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Moderately well-drained</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Well-drained</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Excessively drained</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Dig Soil Test Holes

Test Holes:
• 3 feet deep
• Fill with water
• Check after 72 hrs
• If water is still present:
  - Find another site
  - Take corrective measures

Dr. Bruce Bordelon, Purdue University
What Can be Done to Improve Soil Drainage

• **Sub-soil before planting**
  - Effective for compacted soils.

• **Plant on raised beds**
  - Suitable on moderately well drained soils.
  - Maybe okay for somewhat poorly drained soils.

• **Install drainage tile**
  - Suitable for somewhat poorly drained soils.
  - Maybe okay of poorly drained soils (distance between tile lines & cost become a factor).
Soil Preparation
Sub-soiling

Only effective if soil has hard pan or similar structure with good soil beneath.

Dr. Bruce Bordelon,
Purdue University
Moisture Holding Capacity

Soil Texture
+
Soil Depth
<table>
<thead>
<tr>
<th>Texture</th>
<th>Inches Per foot</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sand</td>
<td>0.5</td>
</tr>
<tr>
<td>Loamy sand</td>
<td>1.0</td>
</tr>
<tr>
<td>Sandy loam</td>
<td>1.5</td>
</tr>
<tr>
<td>Loam</td>
<td>2.0</td>
</tr>
<tr>
<td>Silt loam</td>
<td>2.5</td>
</tr>
<tr>
<td>Clay loam</td>
<td>2.5</td>
</tr>
<tr>
<td>Clay</td>
<td>2.0</td>
</tr>
</tbody>
</table>

With depth, determines if irrigation is necessary
Soil pH for Grapes

- **Optimum:** 5.5 to 6.5
  - American: 5.0 to 6.5
  - French Hybrid: 5.5 to 6.5; will tolerate a pH up to 7.0

- **Iowa Soils:**
  - 4.5 for some sands in eastern Iowa
  - 8.4 in northwest Iowa
  - Most Iowa soils are in near-neutral (7.0) to slightly alkaline (7.4) range. However, long term use of anhydrous ammonia can lower the pH to below 6.5.

- **Adjust Soil pH:**
  - Below 5.5: bring up to 6.0 or 6.5 with lime.
  - Above 7.0: consider lowering to 6.5 or 6.0 with sulfur, or using acid forming fertilizers (ammonium sulfate).
Lime Requirement
to Raise the Soil pH to 6.5 and 6.0

Buffer pH

Tons of Limestone / Acre

pH 6.5
pH 6.0
Sulfur Requirement to Reduce the Soil pH to 6.5

Soil texture influences the amount of sulfur required to acidify a soil.
Soil pH

* Samples submitted from potential vineyard sites.
Soil Fertility

• Least concern when selecting a site.
  Can amend the soil.

• Iowa Soils: Concern for
  - P  Low in many Iowa soils.
  - K  Grapes have a high requirement for K, and many Iowa soils tie up K under non-cultivation as would occur in a vineyard.
  - Zn Grapes have a relatively high requirement for Zn, and it is low in many Iowa soils.

• Pre-plant Soil Tests:
  Ca (in lime), P, & K move very slowly in the soil & are very difficult to correct after planting.

• Collect samples from 2 depths:
  0 to 6 (8) inches  -  Past fertilizer history
  6 (8) to 12 (18) inches  -  Parent material
Availability of Essential Mineral Nutrients

- Composition of the soil parent material.
- Soil pH
- Soil weathering / leaching
- Soil organic matter content
- Previous fertilizer history
Pre-plant Soil Test

- Test for: pH, P, K, Zn, O.M.
- Separate sample for each soil type.
- Separate samples for different cropping histories (corn / soybean rotation can be considered a single cropping history).
- Submit samples collected from 2 depths:
  - 0 to 6 or 8 inch depth.
  - 6 or 8 inch to 12 or 16 inch depth.
- For samples sent to the ISU Soil Testing Lab. indicate on submission form that the results be sent to me for interpretation.
Soil Organic Matter

• Improves soil structure, moisture retention and fertility.
  2 to 3% is considered ideal for grapes.

• Iowa Soils:
  Range from < 1% up to 20%
  Well-drained soils in the 3 to 4% range
  OM is higher in poorer drained soils.

• Grapes grown on high organic soils tend to be less winter hardy.

  Release of N from organic matter.
  20 lb N / % OM / Ac / Yr

  With the indeterminate growth habit of grapes, excessive N promotes vigorous vegetative growth late into the fall, and the inability of the shoots to acclimate for the winter.
Darker the color, higher the organic matter content.
Soil Organic Matter

Samples submitted from potential vineyard sites.
## Desirable Soil Test Ranges for Grapes

<table>
<thead>
<tr>
<th>Test</th>
<th>Bul. 861*</th>
<th>Corn / Soybeans</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
<td>5.5 to 6.5</td>
<td>- -</td>
</tr>
<tr>
<td>Organic matter</td>
<td>2 to 3 %</td>
<td>30 ppm</td>
</tr>
<tr>
<td>Phosphorous (P)</td>
<td>20 to 50 ppm</td>
<td>150 ppm</td>
</tr>
<tr>
<td>Potassium (K)</td>
<td>125 to 150 ppm</td>
<td>- -</td>
</tr>
<tr>
<td>Magnesium (Mg)</td>
<td>100 to 125 ppm</td>
<td>- -</td>
</tr>
<tr>
<td>Boron (B)</td>
<td>.75 to 1.0 ppm</td>
<td>&gt; 1 ppm</td>
</tr>
<tr>
<td>Zinc (Zn)</td>
<td>4 to 5 ppm</td>
<td></td>
</tr>
</tbody>
</table>

* Midwest Small Fruit Pest Management Handbook
Soil Phosphorous (P)

* Samples submitted from potential vineyard sites.
Soil Potassium (K)

* Samples submitted from potential vineyard sites.
Soil Zinc (Zn) *

* Samples submitted from potential vineyard sites.

Zn (ppm)
- < .5
- .5 - 1.0
- 1.1 - 2.5
- 2.6 - 3.9
- ≥ 4.0
ISU Soil Testing Laboratory

- **Phone:** (515) 294-3076
- **Web:** http://www.agron.iastate.edu/soiltesting/
- **Publication:** ST-11 “Soil sample information sheet for horticultural crops”
  
  http://www.extension.iastate.edu/Publications/ST11.pdf
- **Sampling kits and submission forms (ST-11)**
  Available at County Extension offices
**Nitrogen**  
the most needed nutrient

<table>
<thead>
<tr>
<th>Source</th>
<th>Fate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fertilizer</td>
<td>Lost from Soil:</td>
</tr>
<tr>
<td>Legumes *</td>
<td>Leaching</td>
</tr>
<tr>
<td>(Fix up to 300 lb / A / yr)</td>
<td>De-nitrification</td>
</tr>
<tr>
<td>Soil organic matter</td>
<td>Taken up by Plants:</td>
</tr>
<tr>
<td>(Releases</td>
<td>• Recycled:</td>
</tr>
<tr>
<td>~20 lb / A / % OM / yr)</td>
<td>Leaves &amp; Prunings</td>
</tr>
<tr>
<td>Lightning</td>
<td>• Removed: Fruit</td>
</tr>
<tr>
<td>(Fix ~10 lb / A / yr)</td>
<td>• Tied up: Old wood</td>
</tr>
</tbody>
</table>

* Planting grapes on land that is currently planted with alfalfa is not recommended. Another crop should be planted on the land for a few years to bring down the nitrogen level before planting grapes.
How Much Nitrogen is Needed?

Mid-Atlantic Wine Grapegrower’s Guide:

• Grapes ~ .18% N, Canes ~ .25% N

• Nitrogen removed:
  - Grapes: 3.6 lb / A / ton
  - Canes: 1.7 lb / A / lb of prunings / vine

• For a 3 ton crop & 2 lb prunings / vine:
  - Grapes: 10.8 lb / A + prunings 3.4 lb / A
How Much Nitrogen is Needed?

Cahoon. *Grapes, Production, Management & Marketing*. Ohio State Bul. 815:

“Most vineyards should receive between 40 and 80 pounds of actual nitrogen per year.”

- Sod occupies 2/3’s of the land and requires ~ 1 lb N / 1000 sq.ft. (~30 lb / A).
- Grapes are receiving from 10 to 50 lb of N per acre.
Need to adjust N fertilization practices based on the organic matter content of your soil.
Summary of Site Considerations

• Select an elevated site to avoid spring frost & extremely low winter temperatures.

• Select a deep, well-drained soil that has an adequate moisture holding capacity, and does not contain excessive organic matter. Check your County Soil Survey.

• Test the soil before planting for pH, P, K, Zn & organic matter content. Amend the soil as needed.

• Select and plant grape varieties that are adapted to your site regarding winter temperature tolerance, length of growing season, and accumulated growing degree days.
Summary of Grape Nutrient Management

• Pre-plant Soil Test: pH, P, K, Zn, O.M.
• Amend soil as needed and incorporate as deep & as uniformly as possible.
• Apply a low rate of N after planting, and in 2\textsuperscript{nd} year. (40-50 lb N / A - .4 to .6 oz N applied around each vine, & the remainder broadcast applied. Adjust based on soil organic matter content.)
• Begin petiole analysis during the 2\textsuperscript{nd} year, and adjust N fertilizer rates based on test results and vine vigor (prunings removed).
• Apply other nutrients as needed based on petiole analysis results.
Vineyard Economics*

- Foch vineyard
  - Moderately vigorous & productive vine
  - Spacing: 7 x 9 ft
  - Vines (691) @ $1.75
  - Line post @ 28 ft
  - Labor @ $8.00 / hr
  - Production potential 3.5 tons / A
  - Sell to a winery @ per ton: $1,000

*See: *Cost of Establishing a Vineyard in Iowa*, and *Estimated Vineyard Establishment Costs per Acre* under “Other ISU Information”
# Vineyard Establishment Cost

<table>
<thead>
<tr>
<th>Description</th>
<th>Cost</th>
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</thead>
<tbody>
<tr>
<td>Pre-plant</td>
<td>169.00</td>
</tr>
<tr>
<td>Planting: (spacing of 7 x 9 ft)</td>
<td>1,209.00</td>
</tr>
<tr>
<td>Vines (691 @ $1.75)</td>
<td></td>
</tr>
<tr>
<td>Planting expenses (w/ planter)</td>
<td>138.00</td>
</tr>
<tr>
<td>Trellising:</td>
<td></td>
</tr>
<tr>
<td>Materials (11 rows, 448 ft long w/ 15 line posts / row @ 28 ft)</td>
<td>1,482.00</td>
</tr>
<tr>
<td>Installation</td>
<td>520.00</td>
</tr>
<tr>
<td>Cultural expenses</td>
<td>1,022.00</td>
</tr>
<tr>
<td>Land charge</td>
<td>120.00</td>
</tr>
<tr>
<td>Operating interest @ 8 %</td>
<td>186.00</td>
</tr>
<tr>
<td>Total Establishment Cost</td>
<td>$ 4,846.00</td>
</tr>
</tbody>
</table>
Number of Post per Acre
At a 9 ft Row Spacing

- Line @ 21 ft
- Line @ 24 ft
- Line @ 28 ft
- End @ 21 ft
- End @ 24 ft
- End @ 28 ft

# of Post per Acre vs # of Line Post per Row
Trellis Materials Cost per Acre
Rows 9 ft apart w/ 2 wires

Row length affects the cost of trellis materials because end post can be as much as 3 times more expensive than line posts. Also with more rows per acre, more wire strainers are required.
The increase in annual expense in Year 3 and 4 is due to the purchase of harvest containers, and an increased pest control program. The decrease in annual expense from year 4 to 9 is from debt reduction.