The Missouri Grape and Wine Industries

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History is our Heritage

George Hussmann

Charles V. Riley

Hermann Jaeger
Phylloxera
Grape species

*Vitis vinifera*; European grapevine, Cabernet sauvignon, Merlot, Syrah, Chardonnay…

*Vitis labrusca*; Fox grapevine, Concord, Catawba

*Vitis riparia*; riverbank or frost grapevine

*Vitis rotundifolia*; muscadines or scuppernongs

*Vitis aestivalis*; summer grapevine, Norton

*Vitis rupestris*; rock grapevine

…a number of native North American grape species have been used to develop Phylloxera resistant rootstocks including; *V. riparia, V. aestivalis, V. rupestris*, and *V. berlanddieri*
Norton

1873 Best Red Wine of All Nations – International Exhibition in Vienna

Missouri Riesling

V. Riparia x V. labrusca Nicholas Grein, Hermann, MO

American Heritage Grape Cultivars

Cultivars developed by Thomas Volney Munson from indigenous North American grape species
Missouri’s Grape and Wine Industry Today

Viticulture
- 1,700 acres of grapes
- Norton (16%), Vignoles (14%), Chambourcin (9%), Chardonel (8%), Concord (8%), Catawba (8%), Vidal Blanc (6%)
- 425 growers

Enology
- 1.25 million gallons ~6.3 million bottles

Economic Impact
- 1 billion in annual wages paid
- 248 million in wine-related tourism expenditures
- 219 million Federal taxes paid
- 144 million in State and local taxes paid

- 3.2 Billion Full Annual Economic Impact of Missouri Wine and Wine Grapes
Missouri’s Grape and Wine Industry Today

MISSOURI WINES

$3.2 BILLION TOTAL ECONOMIC IMPACT

$218.5M FEDERAL TAXES

$144M STATE & LOCAL TAXES

$1.0B IN ANNUAL WAGES

28,052 Jobs

130+ Wineries

$247.8M Tourist Expenditures

875,700 Wine-Related Tourists

1700 Acres

3-4 TONS per Acre

425 Grape Growers

$1.16M Gallons Sold
Missouri Wineries

<table>
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<th>Year</th>
<th>2000</th>
<th>2005</th>
<th>2012</th>
<th>2015</th>
<th>2018</th>
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<td>No.</td>
<td>31</td>
<td>50</td>
<td>108</td>
<td>128</td>
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Vineyard Acres and Number of Farms

<table>
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<tbody>
<tr>
<td>Acres</td>
<td>970</td>
<td>1453</td>
<td>1773</td>
<td>1828</td>
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<tr>
<td>Farms</td>
<td>294</td>
<td>328</td>
<td>393</td>
<td>425</td>
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Grape and Wine Institute

• At the University of Missouri since 2007
• Annual GWI budget of ~$850,000
• Funded by $0.12/gallon tax on wine sold in Missouri
• GWI is budget overseen by Missouri Wine and Grape Board
• Three faculty positions
  • Enology Research Leader – Misha Kwasniewski, Food Science
  • Viticulture Research Leader – Megan Hall, Plant Science
  • Extension Leader – Dean Volenberg, Plant science
• Staff
  • Connie Liu – Senior Research Specialist, Kwasniewski
  • Zhiwei Fang – Senior Research Specialist, Hall
  • Nick Frost – Research Specialist I, Vineyard Technician
• Vineyard Research Sites
  • South Farm – Columbia
  • Southwest Center – Mount Vernon
  • Horticulture Agroforestry Research Center (HARC) – New Franklin
Beginner Grape School

1. Introduction into the Missouri Grape and Wine Industry
2. Cost of establishing a vineyard
3. Vineyard pest management
4. Spray management and use
5. Vineyard site selection
6. Grape cultivars and sources
7. Vineyard establishment
8. Trellis design and construction
9. Pruning and canopy management
10. Harvest considerations and fruit quality
11. Marketing and building relationships
12. Q & A
Growing Grapes-Market Research

- What grape cultivar will the market demand in 3, 5, 10…30 years?

- What will the “aspirationals” want?

- How will your grape management practices deliver intangible value to your product?
  - Integrated pest management
  - Sustainability
  - Organic

- Don’t make the mistake and grow grapes and make wine because you like a certain type of grape or style of wine. You are not the consumer!
Growing Grapes

Site Selection

- Well drained soil
- Slope – cold air drainage
- Previous cropping history
- Soil analysis for nutrients
- Water availability - irrigation
Growing Grapes

Trellis construction and vine training

• High-wire cordon, Vertical shoot position

• Vine training is dictated by the trellis system employed

• Most vineyards in Mo use high-wire cordon for mechanical harvest
Growing Grapes - Pest management

- Deer during establishment
- Insect pests – phylloxera, Japanese beetle, Grape flea beetle, Leafhopper spp., Grape berry moth, Yellow jackets, Multicolored Asian ladybeetles, Grape root borer
- Disease pests – Downy mildew, Powdery mildew, Phomopsis, Black rot, Anthracnose, Assorted rots
- Birds
Growing Grapes
Growing Grapes
Growing Grapes
Winemaking

~ a natural process aided by the creative artful mastery of a winemaker

1. Harvest of the grapes determines the sweetness, acidity, and flavor

2. Crushing and Pressing
   • Must is freshly pressed juice and skins, seeds, and solids
   • Free juice is juice separated from skins, seeds, and solids

3. Fermentation; sugars converted to ethanol by yeast
   • Dry wines all the sugars converted to ethanol
   • Sweeter wines with residual sugar can be produced by arresting fermentation prior to complete dryness

4. Clarification –Cold Stabilization
   • Transfer of wine to another vessel “racked”
   • Fining and Filtration

5. Bottling/Aging
   • Barrel aging
White Wine Production

1. Destem and crush
2. Press
3. Ferment
4. Age in Barrels
5. Transfer to Stainless Steel Tank or Barrels
6. Settle
7. Filter
8. Bottle and age
Red Wine Production

1. Destem and crush
2. Ferment
3. Press
4. Transfer to new Barrels
5. Settle
6. Age in Barrels
7. Filter
8. Bottle and age
Winemaking - Fermentation

- \( \text{C}_6\text{H}_{12}\text{O}_6 \rightarrow 2\text{C}_2\text{H}_5\text{OH} + 2\text{CO}_2 \)
- Under mostly anaerobic conditions
- Carried out by yeast

- L-malic acid $\rightarrow$ \( \text{CO}_2 + \text{L-Lactic Acid} \)
- Carried out by lactic acid bacteria
- Deacidification of wine
Winemaking - Fermentation

\[ C_6H_{12}O_6 \rightarrow 2 \text{CH}_3\text{CH}_2\text{OH} + 2 \text{CO}_2 \]

- glucose → 2 ethanol
- 2 carbon dioxide

1° Brix drop → 2.3°F rise
Winemaking – Fermentations and Heat

• How Hot?
  – Dependent on sugar concentration in the fruit
  – Dependent on ambient temperature

• Example: 22°Brix juice at 70°F
  
  \[
  22 \times 2.3 = 50.6°F \text{ rise}
  \]
  
  \[
  50.6° + 70° = 120°F
  \]

• Primary Grape Wine Fermentation Temperatures
  – Whites low 60’s to low 70’s
  – Reds mid 70’s to mid 80’s
Winemaking – Fungi

- **Saccharomyces cerevisiae**
- Other genera found on grapes and in wine:
  - Brettanomyces
  - Kloechera
  - Hanseniaspora
  - Candida
  - Hansenula
  - Pichia
Winemaking – Fungi

- Native yeast genera die at low alcohol concentrations and are inhibited by SO$_2$
- Selected yeast strains of *S. cerevisiae*
  - Tolerant of elevated SO$_2$
  - Tolerant of elevated alcohol levels
  - Die once substrate (sugar) is fully converted to alcohol
Winemaking – Bacteria

Malolactic Fermentation

Malic acid + Lactic acid bacteria → Lactic acid + carbon dioxide

MLF can be stopped by SO$_2$
  • Riesling and Chenin blanc

Wines contain
• Tartaric acid
• Malic acid
  • High levels in cold climate viticultural areas
  • Low levels in warm climate viticultural areas
• Citric acid
Fermentation

**Bread**  \[ C_6H_{12}O_6 \rightarrow 2 \text{CH}_3\text{CH}_2\text{OH} + 2 \text{CO}_2 \]
- Ethanol driven off by heat during baking
- Carbon dioxide causes the bread to rise

**Soy-Sauce**  \[ C_6H_{12}O_6 \rightarrow 2 \text{CH}_3\text{CH}_2\text{OH} + 2 \text{CO}_2 \]
- Aspergillus fungus – break down proteins
- Yeast – break down sugars to ethanol. Ethanol broken down in secondary reactions
- Bacillus spp.
- Lactobacillus spp. produces lactic acid

**Balsamic vinegar**  \[ C_6H_{12}O_6 \rightarrow 2 \text{CH}_3\text{CH}_2\text{OH} + 2 \text{CO}_2 \]
\[ \text{CH}_3\text{CH}_2\text{OH} \rightarrow \text{CH}_3\text{COOH} \text{ (acetic acid)} \]
- Acetobacter spp.
References

Web Soil Survey
http://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm

California Soil resource Lab – SoilWeb Apps
http://casoilresource.lawr.ucdavis.edu/soilweb-apps/

Midwest Regional Climate Center
http://mrcc.isws.illinois.edu/

Soil Testing and Plant Diagnostic Services
http://soilplantlab.missouri.edu/soil/

Grape and Wine Institute
http://gwi.missouri.edu/

For More Information on Vineyard Site Selection and Layout

Thanks to my colleagues at the Grape and Wine Institute

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Megan Hall – Viticulture Research Leader

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