Grape and Wine Institute
University of Missouri

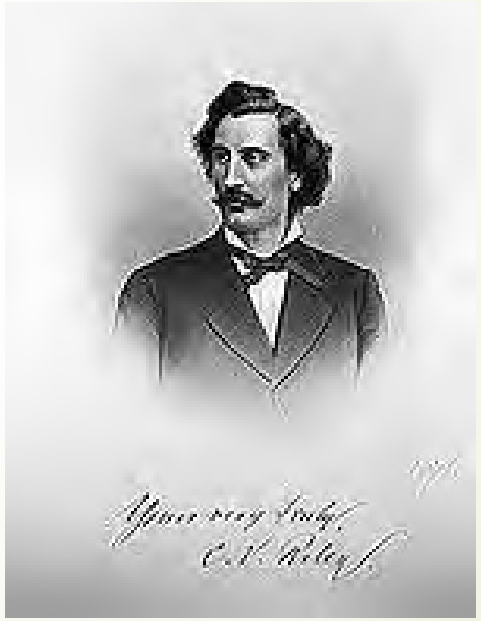
Plant Sciences
College of Agriculture, Food and Natural Resources

The Missouri Grape and Wine Industries

Dean S. Volenberg
Viticulture and Winery Operations Extension Specialist
Grape and Wine Institute
volenbergd@missouri.edu

History is our Heritage

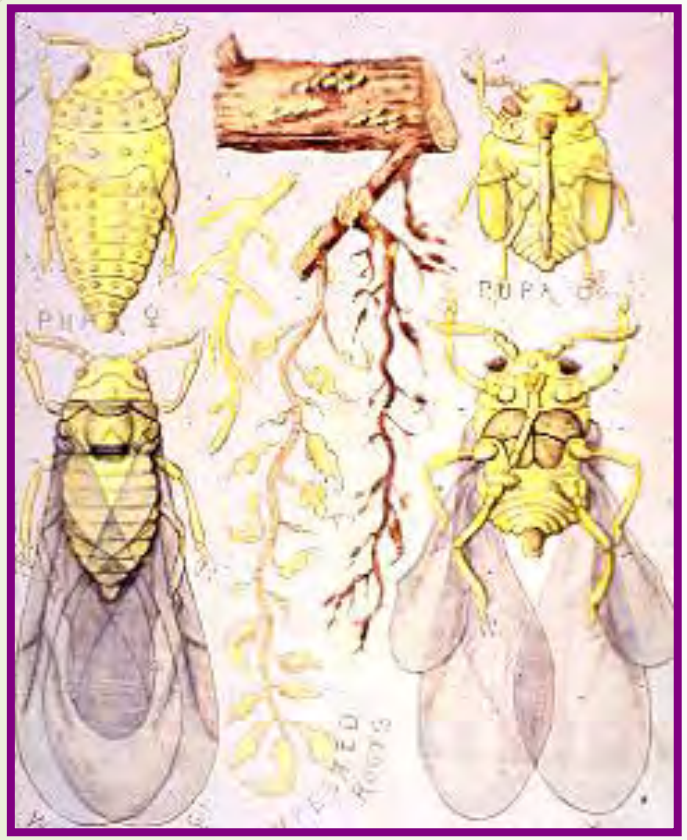
George Hussmann



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

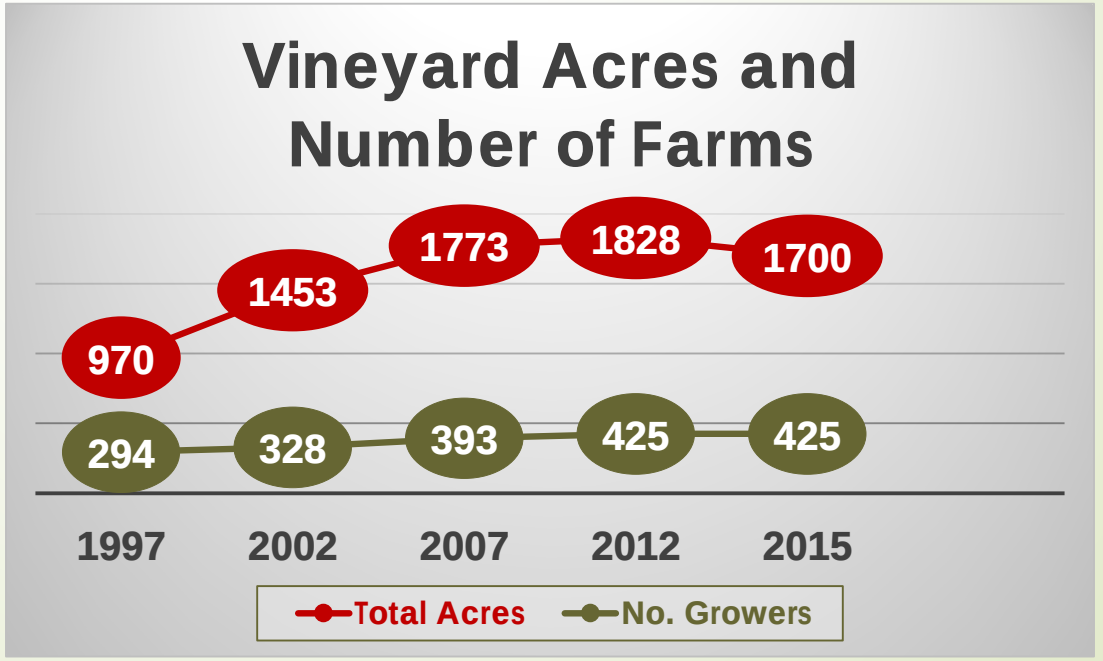
Economic Impact

- 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 Wineries
31
50
108
128
130
2000
2005
2012
2015
2018


Vineyard Acres and Number of Farms
970
1453
1773
1828
1700
294
328
393
425
425
1997
2002
2007
2012
2015
Total Acres
No. Growers

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

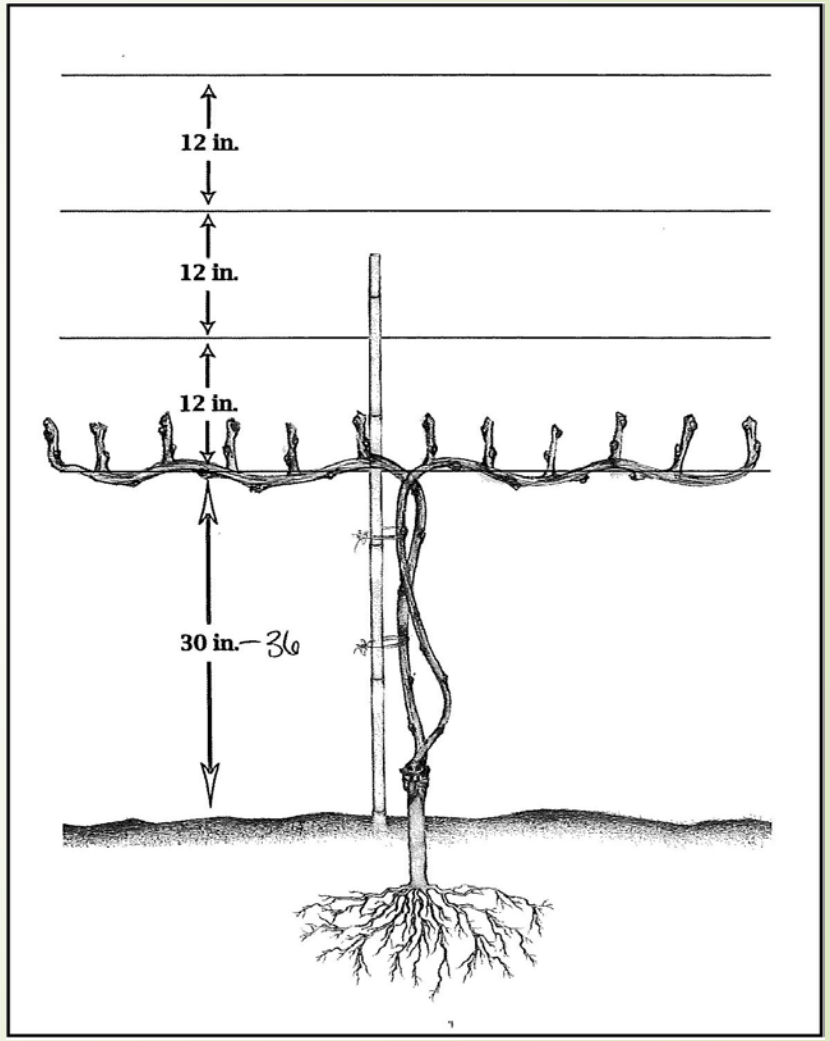
Site Selection

- 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



MyWay | Successf... | cli-MATE... | WeatherB... | MyWay | Interactive M... | WeatherB... | MyWay | WeatherB... | MyWay | Web Soil ... | Web ... | WeatherB... | MyWay

websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx

Search

Most Visited | Getting Started

Area of Interest

Import AOI

Quick Navigation

Address

View

Address: 25056 Highway J Mexico, MO 65265

Show location marker

View

- State and County
- Soil Survey Area
- Latitude and Longitude
- PLSS (Section, Township, Range)
- Bureau of Land Management
- Department of Defense
- Forest Service
- National Park Service
- Hydrologic Unit

Legend

View Extent: Contiguous U.S.

Scale: (not to scale)

USDA United States Department of Agriculture
Natural Resources Conservation Service

Web Soil Survey

Search

Map Unit Legend

Audrain County, Missouri (MO007)

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
50008	Keswick silt loam, 5 to 9 percent slopes, eroded	0.9	69.6%
60006	Marion silt loam, 2 to 5 percent slopes	0.4	30.4%
Totals for Area of Interest		**1.4**	**100.0%**

Soil Map

Legend

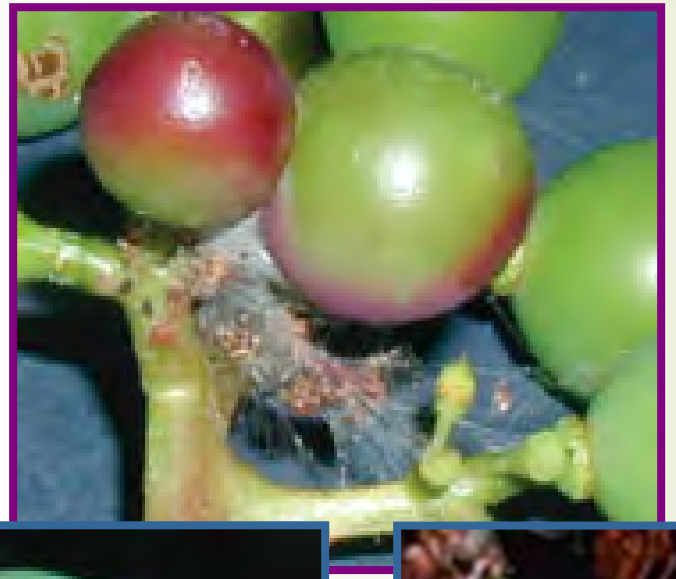
Scale (not to scale)

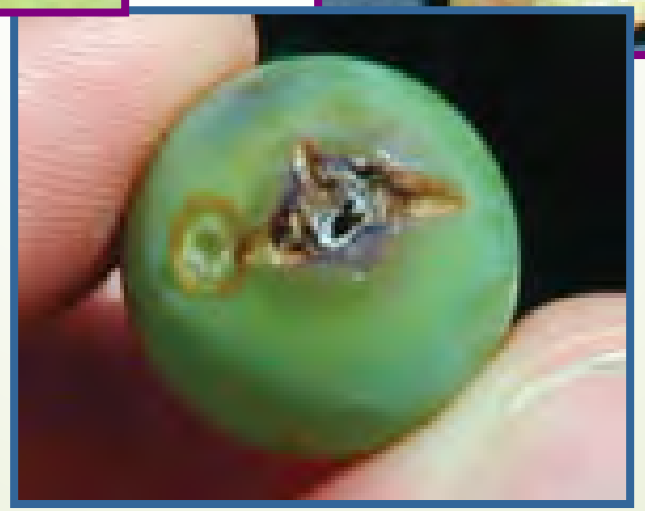
Growing Grapes-Pest management

- 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

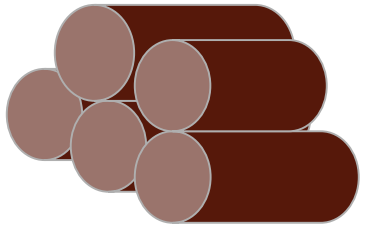
White Wine Production

Destem and crush

Press

Ferment

Transfer to Stainless Steel Tank or Barrels



Age in Barrels

Settle

Filter

Bottle and age

Red Wine Production

Destem and crush

Ferment

Press

Age in Barrels

Transfer to new Barrels

Settle

Filter

Bottle and age

Winemaking - Fermentation

- $C_6H_{12}O_6 \rightarrow 2C_2H_5OH + 2CO_2$
- Under mostly anaerobic conditions
- Carried out by yeast

- L-malic acid $\rightarrow$ CO_2 + L-Lactic Acid
- Carried out by lactic acid bacteria
- Deacidfication of wine

Winemaking - Fermentation

$C_6H_{12}O_6 \rightarrow 2\ CH_3CH_2OH + 2\ CO_2$

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 x 2.3 = 50.6°F 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*
  - *Kloeckera*
  - *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 $C_6H_{12}O_6 \rightarrow 2\ CH_3CH_2OH + 2\ CO_2$

- Ethanol driven off by heat during baking
- Carbon dioxide causes the bread to rise

Soy-Sauce $C_6H_{12}O_6 \rightarrow 2\ CH_3CH_2OH + 2\ CO_2$

- 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 $C_6H_{12}O_6 \rightarrow 2\ CH_3CH_2OH + 2\ CO_2$

$CH_3CH_2OH \rightarrow CH_3COOH$ (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

Wolf, T. K. (editor). 2008. **Wine Grape Production Guide**. Natural Resource, Agriculture, and Engineering Service. Cooperative Extension. NRAES-145. Ithaca, N.Y. 336 p.

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Thanks to my colleagues at the Grape and Wine Institute

Misha Kwasniewski – Enology Research Leader
Megan Hall – Viticulture Research Leader

Dean Volenberg
University of Missouri Grape and Wine Institute
214 Waters Hall
Columbia, MO 65211

573-882-0476
volenbergd@Missouri.edu