Redeveloping Vineyards
What to Consider

UC Davis and UC ANR Grapevine Short Course
February 13, 2019

Rhonda Smith
Viticulture Farm Advisor
Sonoma County
Photo and Slide Acknowledgements

- Andrew Walker, UC Davis Department of Viticulture and Enology
- Howard Ferris, UC Davis Department of Nematology
- VineView, Napa
- Mark Greenspan, Advanced Viticulture, Windsor
- Paul Anamosa, Vineyard Soil Technologies, Napa
- Doug Beck, Monterey Pacific, Inc., Soledad
- Pete Opatz, Route 128 Winery, Geyserville
- Jose Urbez-Torres, Agriculture and Agri-Food Canada, Summerland, BC, Canada
- Mike Bobbitt, Mike Bobbitt and Associates
- Ray Carlson and Associates, Santa Rosa
Redeveloping vineyards: what to consider

• Factors to consider when deciding if an established vineyard should be redeveloped.
• How subsequent vineyard design and plant material decisions are informed by previous vineyard’s performance
• Assessing the need for pre-plant fumigation
• Rootstock choices based on site concerns
• Spacing and trellising considerations
Factors to consider when deciding an established vineyard should be redeveloped.

• Yield reduction due to pests and disease
  • Grapevine trunk disease
  • Virus disease
  • Soil borne pests

• Fruit quality is negatively affected by grapevine virus diseases *

• Vine growth is restricted by soil factors

• Cultivar is in less demand and/or grown in a region not considered optimal; price per ton is not sustainable
Uniform canopies
Acceptable yields
The Vine Illumination Analysis allows us to model:

- Day of the year
- Time of day
- Vine spacing
- Vine Height
- Fruitwire Height
- Slope
- Aspect

Sun azimuth & elevation angles for a particular day and time

Row Direction Optimization – mapping canopy exposure in the warmest period of the season

Mike Bobbitt & Associates
http://www.mikebobbitt.com
Grapevine trunk disease

Chardonnay

Zinfandel
Trunk Diseases in California

- Caused by fungal pathogens (Ascomycetes)
- Infect grapevines through wounds and openings
- Symptoms include:
  - Grapevine decline
    - Dead arms, cordons and trunk
    - Blockage of vascular system
    - Yield losses / Death of the plant
  - Arm and Trunk dieback - *Eutypa spp.* and other Diatrypaceae
Converting vines from cordon trained and spur pruned to cane pruned
Percentage of planted acres producing fruit
Virus disease: Grapevine red blotch disease

Caused by Grapevine red blotch-associated Virus

Chardonnay

Merlot
Virus disease: Grapevine leafroll disease

Caused by species of Grapevine leafroll-associated Virus

Spread documented by Golino & Weber (California Agriculture, 2008)

Insect vectors: Mealybugs and scale
Fanleaf degeneration

Caused by:
Grapevine fanleaf virus

Nematode vector:
Xiphinema index

Merlot on 110R

Zinfandel on St. George
Six year old Pinot noir vineyard removed

Ring nematode abundance prevented adequate cane growth; reduced yields
Grape Phylloxera
*Daktulosphaira vitifoliae*
2005; Phylloxera infested 101-14

1989; Phylloxera infested Chardonnay on AXR#1
Damage

Tuberosities

Fungal necrosis

Root death

Vine stunting, yield decline, vine death

Shorter rootlet lifespan

Nodosities
When should you fumigate prior to planting for nematodes?

Untarped Telone II application prior to replanting a vineyard.

Photo: Larry Bettiga
California Grapes: Co-distribution of Nematode species

Many of these are not native species. Why are they there?

…..the importance of nursery certification and clean planting stock

North Coast
Xiphinema index
Mesocrictonema xenoplax
Pratylenchus vulnus

Central Coast
Meloidogyne spp.
Xiphinema index
Mesocrictonema xenoplax

Central Interior
Meloidogyne spp.
Xiphinema americanum
Tylenchulus semipenetrans
Mesocrictonema xenoplax
Pratylenchus vulnus

Northern Interior/Foothills
Mesocrictonema xenoplax

Southern Interior
Meloidogyne spp.
Xiphinema americanum
Tylenchulus semipenetrans
Mesocrictonema xenoplax

Slide source: Howard Ferris
### Host status of grape rootstocks to nematodes

<table>
<thead>
<tr>
<th>Genotype</th>
<th>Parentage</th>
<th><em>Meloidogyne</em> pathotypes</th>
<th><em>X. americanus</em></th>
<th><em>Parasitica hamatus</em></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td><em>M. incognita</em> Race 3</td>
<td><em>M. javanica</em> A&amp;C</td>
<td><em>M. chitwoodi</em> index</td>
</tr>
<tr>
<td>101-14Mgt</td>
<td>V. riparia, V. rupestris</td>
<td>R</td>
<td>S</td>
<td>S</td>
</tr>
<tr>
<td>1103Paulsen</td>
<td>V. solonis x V. riparia</td>
<td>S</td>
<td>S</td>
<td>S</td>
</tr>
<tr>
<td>110Richter</td>
<td>V. berlandieri, V. rupestris</td>
<td>MR</td>
<td>S</td>
<td>S</td>
</tr>
<tr>
<td>140Ruggeri</td>
<td>V. berlandieri, V. rupestris</td>
<td>MR</td>
<td>S</td>
<td>S</td>
</tr>
<tr>
<td>1613Couderc</td>
<td>V. solonis, V. othello</td>
<td>R</td>
<td>R</td>
<td>S</td>
</tr>
<tr>
<td>1616Couderc</td>
<td>V. solonis, V. riparia</td>
<td>MR</td>
<td>S</td>
<td>S</td>
</tr>
<tr>
<td>3309Couderc</td>
<td>V. riparia, V. rupestris</td>
<td>S</td>
<td>S</td>
<td>S</td>
</tr>
<tr>
<td>420A</td>
<td>V. berlandieri, V. riparia</td>
<td>R</td>
<td>S</td>
<td>S</td>
</tr>
<tr>
<td>44-53Malegue</td>
<td>V. riparia, V. cordifolia, V. rupestris</td>
<td>S</td>
<td>S</td>
<td>S</td>
</tr>
<tr>
<td>AxR1</td>
<td>V. vinifera, V. rupestris</td>
<td>R</td>
<td>R</td>
<td>S</td>
</tr>
<tr>
<td>Borne</td>
<td>V. riparia, V. cinerea</td>
<td>R</td>
<td>R</td>
<td>S</td>
</tr>
<tr>
<td>Dog Ridge</td>
<td>V. chaminii</td>
<td>R</td>
<td>R</td>
<td>S</td>
</tr>
<tr>
<td>Freedom</td>
<td>V. chaminii, V. longii, V. vinifera, V. riparia, V. labrusca</td>
<td>R</td>
<td>R</td>
<td>S</td>
</tr>
<tr>
<td>Harmony</td>
<td>V. chaminii, V. longii, V. vinifera, V. riparia, V. labrusca</td>
<td>R</td>
<td>R</td>
<td>S</td>
</tr>
<tr>
<td>K51-32</td>
<td>V. chaminii, V. rupestris</td>
<td>R</td>
<td>R</td>
<td>S</td>
</tr>
<tr>
<td>Kober 5BB</td>
<td>V. berlandieri, V. riparia</td>
<td>R</td>
<td>R</td>
<td>S</td>
</tr>
<tr>
<td>Ramsey</td>
<td>V. riparia</td>
<td>R</td>
<td>R</td>
<td>S</td>
</tr>
<tr>
<td>Riparia Gloire</td>
<td>V. riparia</td>
<td>R</td>
<td>R</td>
<td>S</td>
</tr>
<tr>
<td>RS-3</td>
<td>V. candidans, V. riparia, V. rupestris</td>
<td>R</td>
<td>R</td>
<td>MR</td>
</tr>
<tr>
<td>RS-9</td>
<td>V. candidans, V. riparia, V. rupestris</td>
<td>R</td>
<td>R</td>
<td>R</td>
</tr>
<tr>
<td>Schwarzmann</td>
<td>V. riparia, V. rupestris</td>
<td>S</td>
<td>MR</td>
<td>S</td>
</tr>
<tr>
<td>St. George</td>
<td>V. riparia</td>
<td>S</td>
<td>S</td>
<td>S</td>
</tr>
<tr>
<td>Teleki 5C</td>
<td>V. berlandieri, V. riparia</td>
<td>S</td>
<td>S</td>
<td>S</td>
</tr>
<tr>
<td>USDA 10-17A</td>
<td>V. simpsoni, M. rotundifolia</td>
<td>R</td>
<td>R</td>
<td>R</td>
</tr>
<tr>
<td>USDA 10-23B</td>
<td>V. doanianana</td>
<td>R</td>
<td>R</td>
<td>R</td>
</tr>
<tr>
<td>USDA 6-19B</td>
<td>V. chaminii</td>
<td>R</td>
<td>R</td>
<td>MS</td>
</tr>
<tr>
<td>VR 039-16</td>
<td>V. vinifera, M. rotundifolia</td>
<td>S</td>
<td>S</td>
<td>S</td>
</tr>
<tr>
<td>GRN-1</td>
<td>MR</td>
<td>R</td>
<td>R</td>
<td>HR</td>
</tr>
<tr>
<td>--------</td>
<td>-----</td>
<td>-----</td>
<td>-----</td>
<td>----</td>
</tr>
<tr>
<td>GRN-2</td>
<td>MR</td>
<td>MS</td>
<td>MS</td>
<td>HR</td>
</tr>
<tr>
<td>GRN-3</td>
<td>MR</td>
<td>MR</td>
<td>MR</td>
<td>R</td>
</tr>
<tr>
<td>GRN-4</td>
<td>MR</td>
<td>MR</td>
<td>MR</td>
<td>R</td>
</tr>
<tr>
<td>GRN-5</td>
<td>MR</td>
<td>MR</td>
<td>R</td>
<td>MS</td>
</tr>
</tbody>
</table>

All GRN rootstocks are resistant to *Xiphenema index*, 3 strains of root-knot nematodes, these combined, and at high soil temperatures.

Remote Sensing In Vineyards

Infrared Imagery

NDVI Imagery

Soil Electrical Conductivity
Goal: Reduce the variability in the block

Vine capacity and site vigor are the primary considerations for vineyard design and canopy management.

- Vineyard design
  - Row orientation
  - Row & vine spacing
  - Trellising
  - Rootstock
Comparison of row direction & shading effects on NDVI and EVI Images

Color Infrared  5/30/14

11:59 am                        2:09 pm

~ solar incidence (am)        ~ solar incidence (pm)

Sun aligned with, or perpendicular to, rows can cause false apparent vigor differences
Comparison of row direction & shading effects on NDVI and EVI Images

Relative NDVI 5/30/14

Shadows related to row direction can cause apparent changes in vigor at specific times of day (between morning and afternoon NDVI images)
Relative EVI
5/30/14

EVI is much less sensitive to shadows & soil boundaries & more directly sensitive to Leaf Area Index

\[ G \times (\text{NIR} - \text{Red}) \]

\[ \text{NIR} + (c_1 \times \text{Red} - c_2 \times \text{Blu} + L) \]

Coefficients:
\( c_1, c_2 = \) aerosol resistance
\( G = \) Gain factor
\( L = \) Canopy background adj. for non-linearity in NIR & Red
FLIGHT INFORMATION

Calibrated EVI - Relative Data Product

Sept. 14, 2018
Date Flown

EVI Values

- Highest Vigor
- Equal Area Classification

- Lowest Vigor
PD; High ring and dagger nematode counts

Low nematode counts; Highly compacted soil

Massive subsoil; High ring and dagger nematode counts

Pure Vine Zones - Relative Pest Pressure

Sept. 14, 2018 Date Flown

EVI Values
- Highest Vigor
- Green
- Yellow
- Orange
- Lowest Vigor

Equal Area Classification
Massive, unstructured subsoil. Not penetrated by roots.
• Where is the root zone?
• Structure, texture, rock content by depth
• Chemistry by depth
• Sample for nematodes
Vibrosoiler
Vibrosoiler
Vibrosoiler
Vibrosoiler
Vine removal

Pluck and Plant

Infrastructure remains intact
Vibrosoiler for mid-row ripping
Vibrosoiler for mid-row ripping
Spacing and trellising considerations

Mechanizing more farming practices will allow you perform practices on time
Practices occur later than optimal
Thank you