Achieving Vine Balance and the Role of Rootstocks

Foothill Grape Day
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• Team Members
  – Mike Anderson, Jason Benz, Janet Myers
Brief Outline

• Vine Balance
  – Principles (from literature)
  – Factors affecting balance
    • Shoot number at pruning (data)
    • Rootstock contribution (data)
  – Conclusions
• Fruit thinning (a little more data)
  – Conclusions
• Question and Answer
Vine Balance

Working Definition:

• When grapevine growth is appropriate for the trellis and spacing
• And the leaf area and amount of fruit are in proper proportion
How many of you have read?


- Leaf area/crop weight ratios of grapevines: Influence on fruit composition and wine quality.
  - *In:* Proceedings of the ASEV 50th Anniversary Annual Meeting, American Society for Enology and Viticulture, Davis, CA.
Vine Balance

Two major contributors

- Conditions of balance are set at planting in the vineyard design (permanent)
  - Soil
  - Rootstock/scion
  - Spacing – row x vine
  - Trellis

- Conditions of balance are acted on by cultural practices (annual)
  - Pruning (shoot number)
  - Nitrogen application
  - Irrigation
  - Cover crops
Vine Balance

• Contributions to vine vigor
  – Given
    • Soil (fertile vs less)
    • Scion (high vigor vs low)
  – Decisions
    • Rootstock (high vigor vs low)
    • Spacing (wide vs narrow)
      – In-row (more than between-row)
    • Trellis (divided vs undivided)
Two Scenarios

• Scenario 1
  – Given
    • Soil: Deep, fertile
    • Scion: Cab Sauv
  – Decision
    • Rootstock: ?
    • Vine spacing: ?
    • Trellis: ?

• Scenario 2
  – Given
    • Soil: Shallow, infertile
    • Scion: Pinot noir
  – Decision
    • Rootstock: ?
    • Vine spacing: ?
    • Trellis: ?

Decisions affect vine balance within given scenarios
• “Spacing defined solely by R x V spacing is only a beginning in the definition of canopies and within-canopy spacing of leaves.”
Dokoozlian and Kliewer
Amer J. Enol. Vitic. 1995

• In too-dense vine canopies:
  – High leaf layer number (by point quadrat analysis)
  – High LA/m row (>1.5 m²/m row) (by leaf area meter)
  – Low PPFD (light): <2% of ambient (by light meter)
  – Low Red:Far-red light ratio (by spectroradiometer)
  – Low sunflecks in fruit zone (sunfleck ceptometer)
  – Low evaporative potential (by atmometer)

• How many of these can you measure?
In too dense vine canopies:
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- Low sunflecks in fruit zone
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Fortunately:

- All are correlated with pruning wt!
Growth measurement

• Pruning wt
  – Expressed per vine is not helpful
  – Expressed per meter (or per ft) is helpful

• Pruning wt metrics
  – Smart and Robinson: 0.3 – 0.6 kg/m
  – Dokoozlian & Kliwer: 1.0 kg/m for Cab Sauv.

Even more informative than pruning wt alone
  – Shoot number
  – Shoot wt
From: Intrieri and Filipetti American Journal of Enology and Viticulture, 50th Anniversary
Shoot number

• Recommended shoot density
  – For cordon-training, undivided
  – 12-15 shoots/meter

• One cannot achieve vine balance by adjusting shoot number outside this range.
Sangiovese Study

- Sangiovese/3309C (5th leaf)
- Atlas Peak Vineyards, Napa
- Three treatments
  - 12, 20 and 28 shoots per vine
- Adjusted in spring
Shoot number affects shoot length

![Graph showing shoot length (m) for different shoot numbers. The graph indicates that the shoot length decreases as the shoot number increases.]
Longer shoots have more leaf area and have a greater % of leaf area as laterals.

![Bar chart showing leaf area (m²/shoot) for primary and lateral leaves with percentages]
Manipulating shoot number per vine does not change leaf area per vine, but changes % primary vs. lateral (J.K. Myers and J.A. Wolpert, unpublished data)
Pruning wt unaffected by shoot number

Myers, J. and J. Wolpert. Unpublished data.
## Shoot number vs. primary and lateral leaf area

<table>
<thead>
<tr>
<th>Primary shoots/m Canopy</th>
<th>Canopy leaf area (m²/m)</th>
<th>Primary LA (m²/m)</th>
<th>Lateral LA (m²/m) (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>7.2</td>
<td>3.4</td>
<td>3.8 (53%)</td>
</tr>
<tr>
<td>12</td>
<td>7.4</td>
<td>4.6</td>
<td>2.8 (38%)</td>
</tr>
<tr>
<td>24</td>
<td>9.2</td>
<td>6.7</td>
<td>2.5 (27%)</td>
</tr>
</tbody>
</table>

Dokoozlian Thesis, 1990
(Unpublished data)
Conclusions from Shoot Number work

• For vines of a given vigor, decreasing shoot number:
  – Redistributes LA from shorter shoots to longer shoots and
  – Increases % lateral LA (in the fruiting zone?)
  – Increases the LA to fruit wt ratio (m²/kg)
  – Decreases the fruit yield/cane prunings ratio (kg fruit/kg prunings)
Rootstocks:
Effect of shoot length on primary and total leaf area.

1993-1994 Beringer Rootstock Trial
Chardonnay Leaf Area per Shoot

Note: % lateral leaf area increases as shoot length increases.
Oakville Cabernet Sauvignon

• Treatments
  – 4 Rootstocks: 3309C, 5C, 110R and O39-16
  – 4 Pruning levels: 5, 7, 10 and 12 buds per lb of prunings

• Conditions
  – Range of vine size from 1 to 4 kg/vine (0.5 kg/m to 2.0 kg/m)
Q: Is average shoot length related to vine size (wt of prunings)?
A: No, it is related to the number of growing points.

Q: Are the rootstocks the same in this response?
A: No, with the same number of growing points on vines of the same size, 110R and 3309C will grow more, while 5C and O39-16 will grow less
Q: Do large vines have more leaf area?
A: Yes, but it more complicated than that (note the scatter around the line)

Q: Is leaf area affected by pruning formula (buds/wt of prunings).
A: No, it just shifts it from fewer longer shoots to more shorter shoots

Q: Is leaf area affected by rootstock?
A: Rootstocks (eg. 110R) would be classified as “more vigorous,”
i.e. have more leaf area.
Conclusions

• Vine Balance
  – Balance is best achieved by vineyard design
    • We don’t know as much about this as we should
    • Opinion: We are at a greater risk of planting vines too closely than too far apart
  – Pruning is not one of the practices to achieve balance
    • When growth is too great: excessive shoot growth and shading will result
    • When growth is too little: shoot numbers (= clusters) will be reduced, affecting yield per acre.
  – Annual practices can be tools to achieve balance
    • Requires inputs that can be costly
Fruit Thinning

• Common practice:
  – At 80% Veraison, remove the final 20% green clusters

• Presumption:
  – Clusters behind in ripening, remain behind throughout ripening
## Experiment

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Timing</th>
<th>Cluster Thinning treatment</th>
<th>Clusters</th>
</tr>
</thead>
<tbody>
<tr>
<td>UT-80R</td>
<td>80% Veraison</td>
<td>retained</td>
<td>reddest 80%</td>
</tr>
<tr>
<td>UT-20G</td>
<td>80% Veraison</td>
<td>retained and tagged</td>
<td>greenest 20%</td>
</tr>
</tbody>
</table>
Conclusion: Clusters that are the last to undergo color change at veraison do not remain less ripe when harvested at high maturity levels.
Fruit Thinning

• Conclusions
  – Practice of late harvest, at high ripeness levels, may change our thinning practice
  – Need confirmation of the effect (only 2 yrs data)
  – Fruit ripening variability needs to be better understood
Questions?

• Thanks for your attention.