Impacts du système de conduite sur les coûts de production et la qualité des fruits

Tim Martinson, Ph. D
Senior Extension Associate
Department of Horticulture
Cornell University

One of the basic principles of viticulture is that vines function best and deliver optimal fruit quality - and quantity - when the grapevine canopy is in balance with the amount of fruit the vine is carrying. This applies whether or not the crop is Concord juice grapes or high-end Cabernet franc. A grower managing a vineyard wants to have the proper ratio of leaf area to fruit to be able to support a reasonable (or large) crop and be able to ripen it.

Too much vegetative growth (under cropping) leads to shoot crowding, excessive shading, numerous leaf layers, and less fruitful buds the following year. Too little leaf area for the amount of fruit present and the fruit won't ripen (overcropping).

The importance of open canopies. Exposure to light directly influences fruit composition. It can improve brix levels, phenolics, and monoterpenes, while reducing acidity. In red varieties, light exposure reduces levels of methoxypyrazines - the compounds responsible for 'green bell pepper' flavors - at harvest. Open canopies also improve light interception by leaves, promote air flow and rapid drying, and thereby reduce disease incidence. Not incidentally, open canopies also make it a lot easier to get good spray deposition and disease control.

Managing canopy density and cropping level can be a multi-faceted process, starting with dormant pruning, continuing with shoot thinning, cluster thinning, canopy zone leaf removal, and shoot tipping or summer hedging.

If you are lucky, and have a moderate vigor site, dormant pruning alone will result in moderate growth conducive to optimal crop levels and an open canopy. Leave the right number of buds and the rest will follow. More often, you may need to use additional canopy management techniques to improve light interception and produce a quality crop.

Training systems and cost. Choice of training systems directly influence the cost and need for canopy management practices, so the benefits of each training system must be weighed against labor requirements for these training systems. Systems such as Vertical Shoot Positioning (VSP) requiring followup canopy management practices cost 30% more in labor than some other systems such as top wire cordon (TWC) – and their higher cost must be weighed against benefits in fruit quality. Many hybrids, including several of the northern grape cultivars, have downward growth habits that may be more suitable to high wire training systems than midwire or low wire systems.

Canopy management practices such as shoot and cluster thinning influence both the light environment and crop levels. I will use several examples from our hybrid canopy management studies in New York to illustrate both the cost per ton and cost per bottle of these practices, and will argue that growers and winemakers need to be able to recoup the cost of these practices by being able to charge more for higher quality wine, or more per ton for producing quality grapes.
Farming for Flavors

Grapes

"Does exhibit cherry and black currant flavors and aromas... but can be much more complex with integrated notes of blackberries, pepper, plum, tobacco, leather, and spice".

Vines in a ‘Box’

- Space
- Vigor
- Shoot density
- Shading

Tools
- Vine Spacing
- Training system
- Irrigation

Canopy Management
- Shoot thinning
- Leaf removal
- Hedging
- Crop Management
- Pruning severity
- Cluster thinning

Viticulture, enology and marketing for cold-hardy grapes

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Training Systems and Canopy Management: Costs and Benefits

Tim Martinson
Senior Extension Associate in Viticulture

Justine Vanden Heuvel
Assistant Professor

Trent Prezsler
Graduate Research Assistant

Corinell University College of Agriculture and Life Sciences New York State Agricultural Experiment Station

"Excess Vigor"

"Exposed"

"Shaded"

"Traminette 2007"
Drought Stress 2005
Inadequate Vigor

The Goal:
Balance

The Challenge:
$$$$

Long Island Merlot
2-3 T/acre $1800-2400/Ton
$25-$40 Bottle Price
2-3 T = $3600 - $7200/acre
Growing costs: $3,400/acre

Finger Lakes
Cayuga White
7-8 T/acre ($500-600/T)
$10 Bottle Price
7-8 T = $3500 - $4800
Growing costs: $1,500-1,800/acre
Concord – Geneva Double Curtain

Lake Erie
Concord
8-10 T/acre
$200-250/Ton

8-10 T = $1,600 - $2,600
Growing costs: >$1,500/acre

Training System and Canopy Management

• What does it cost?
• What are the benefits?

Examples
– Shoot thinning on hybrids
– Marechal Foch Shoot thin and Harvest date
– Riesling and cluster thinning

Cane-Pruned Vertical Shoot Positioning
Summer Hedging ‘Shoot Tipping’

Hosmer Winery – Cayuga Lake

Marechal Foch
Umbrella Kniffen

Dechanonac
Top Wire Cordon

Pinot gris
Vertical Shoot Positioning - Cane
Varietal growth habit

Vertical

Lateral

Hudson River Umbrella system, Vignoles, Research Station, Summerland, BC

Canopy Management for High Cordon (or Umbrella)?

- Hedging/Leaf Removal (not practical)
- Shoot positioning (yes - combing)
- Shoot thinning (yes)
- Cluster thinning (yes – but often not necessary)
The best canopy management is when possible no canopy management
- Canopy management costs money
- Canopy management often reduces yield
- Payoff: increased quality or marketability

Inputs:
- Labor
- Potential Crop

Output:
- Riper Fruit, Better Wine
- ‘Willingness to Pay’

Canopy Management:
One Component of Cropping System
- Vineyard design (spacing, rootstocks, etc)
- Choice of Training System
- Pruning intensity
- Canopy and Crop Management
  - Shoot Number
  - Cluster Number
  - Berry Number
  - Leaf Removal
  - Shoot Tipping
  - Shoot Positioning

Yield components
Leaf Area/Light Environ.

Vine Capacity and Vigor
- Soil depth, texture
- Water Holding Capacity
- Organic matter/Fertility

Vigor = Rate of shoot growth
Vine Capacity = Sustainable cropping level
Crop Load = Ratio of exposed leaf area to crop

Diagram courtesy Terry Bates, Viticulture Research Associate
Cornell Lake Erie Research and Extension Laboratory, Portland, NY
Vigor and Water Holding Capacity

- Soil Texture determines available water per unit of soil volume.
- Soil depth determines amount of water stored.

Roots are the Dominant Storage Organ

Shoot Vigor

Dormant Vine

<table>
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<tr>
<th>Dry Weight</th>
<th>Starch</th>
<th>N</th>
<th>P</th>
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<td>41%</td>
<td>16%</td>
<td>25%</td>
<td>23%</td>
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<tr>
<td>59%</td>
<td>84%</td>
<td>75%</td>
<td>77%</td>
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Canopy Management for High Cordon (or Umbrella)?

- Hedging/Leaf Removal (often not practical)
- Shoot positioning (yes - combing)
- Shoot thinning (yes)
- Cluster thinning (yes)

How much does it cost?
What are the benefits?

Shoot thinnings Costs

TIME | CROP
--- | ---
15 sec/vine | Cabernet Franc @ $1500/T
6x9 spacing = 806 vines/acre | 0.5 T/acre removed
202 min/acre = 3.35 hours/acre | $750 lower receipts
X $12/hour = $40.20

Need: $790.38/acre more in ‘quality’
Late Shoot Thinning

Leon Millot Shoot Thinning

Grower Demos - Shoot Thinning

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Unthinned</th>
<th>Thinned</th>
<th>Percentage Reduction</th>
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<tr>
<td>Shoots per vine</td>
<td>44.7</td>
<td>28.6</td>
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<tr>
<td>Clusters per vine</td>
<td>105</td>
<td>56</td>
<td>-47%</td>
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<td>Crop wt per vine/lb</td>
<td>5.10</td>
<td>3.63</td>
<td>-29%</td>
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<tr>
<td>Tons per acre</td>
<td>4.0</td>
<td>2.8</td>
<td>-29%</td>
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<tr>
<td>Cluster Weight (g)</td>
<td>22.9</td>
<td>30.0</td>
<td>+31%</td>
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<tr>
<td>Berry weight (g)</td>
<td>0.78</td>
<td>0.91</td>
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<td>Berries per cluster</td>
<td>29.4</td>
<td>32.8</td>
<td>+11%</td>
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Fruit Chemistry

- Berry Weight (g) 0.914
- pH 3.0
- TA 15.1

Thinning: 18 second/vine
968 vines per acre
Grower’s costs and returns
Leon Millot

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Yield</th>
<th>Crop value</th>
<th>Cost of thinning</th>
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<td>4</td>
<td>$3,200.00</td>
<td>Vines per acre</td>
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<tr>
<td>Thinned</td>
<td>2.8</td>
<td>$2,240.00</td>
<td>Seconds/vine</td>
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<td>Difference</td>
<td>1.2</td>
<td>$960.00</td>
<td>Time thin hr</td>
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<td>Cost of thinning</td>
<td>$53.24</td>
<td>Cost at $11/hour</td>
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<td>Total cost</td>
<td>$1,013.24</td>
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At $800 per ton:

To maintain net returns, Grower needs to be paid $1162/ton
To maintain net returns, Winery needs to add $0.50/bottle to price

Dollars (Unthinned)
$20/bottle retail

1.1 T less fruit/acre
X 63 cases/ton
X 12 bottles = 831 bottles
= $16,620 lower gross receipts
Thinned price = $27.50/bottle (approx)

Traminette Shoot Thinning

<table>
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<th>Treatment</th>
<th>Thinned</th>
<th>Unthinned</th>
<th>% change</th>
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<tr>
<td>Clusters</td>
<td>45.8</td>
<td>63.3</td>
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<tr>
<td>Cluster wt</td>
<td>155.9</td>
<td>129.2</td>
<td>21%</td>
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<tr>
<td>Tons/acre</td>
<td>6.3</td>
<td>7.3</td>
<td>-13%</td>
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</table>

Grower’s costs and returns
At $600 per ton:

Cost of thinning
Vines per acre: 805
Seconds/vine: 17
Time thin hr: 3.6
Cost at $11/hour: $42

To maintain net returns, Grower needs to be paid $691/ton
To maintain net returns, Winery needs to add $0.13/bottle to price

Income and thinning

Cost per ton & Per Bottle

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<th>Original</th>
<th>Tons left</th>
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<th>$400</th>
<th>$750</th>
<th>$1,000</th>
<th>$1,250</th>
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<td>1</td>
<td>2</td>
<td>$1.01</td>
<td>$0.40</td>
<td>$0.35</td>
<td>$0.32</td>
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<td>2</td>
<td>3</td>
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<td>$0.41</td>
<td>$0.36</td>
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<tr>
<td>3</td>
<td>4</td>
<td>$1.01</td>
<td>$0.42</td>
<td>$0.37</td>
<td>$0.34</td>
<td>$0.37</td>
<td>$0.32</td>
</tr>
<tr>
<td>4</td>
<td>5</td>
<td>$1.01</td>
<td>$0.38</td>
<td>$0.33</td>
<td>$0.30</td>
<td>$0.33</td>
<td>$0.28</td>
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<tr>
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<td>6</td>
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<td>$0.29</td>
<td>$0.24</td>
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<tr>
<td>6</td>
<td>7</td>
<td>$1.01</td>
<td>$0.30</td>
<td>$0.25</td>
<td>$0.22</td>
<td>$0.25</td>
<td>$0.20</td>
</tr>
<tr>
<td>7</td>
<td>8</td>
<td>$1.01</td>
<td>$0.26</td>
<td>$0.21</td>
<td>$0.18</td>
<td>$0.21</td>
<td>$0.16</td>
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</table>
Shoot thinning, harvest date
Marechal Foch 2007

Control Shoot-thinned
Early harvest: Sept. 11
Late harvest: Sept. 18

Foch

Yield (tons/acre)

CE = control, early harvest, CL = control, late harvest
STE = shoot thinned, early harvest, STL = shoot thinned, late harvest

Foch

• Brix: 22.7 - 24.3 (harvest date only)
• pH: 3.62 - 3.70 (harvest date only)
• TA: 8.67 – 9.50 g/L (ST and harvest date)
Foch

**Harvest Date**

**Shoot Thin**

CE = control, early harvest, CL = control, late harvest
STE = shoot thinned, early harvest, STL = shoot thinned, late harvest

---

ST and harvest date impact Foch aroma compounds

- Fruits: banana, apple, rose
- Solvents: sweat, cheese, smoke
- Botanicals: clove, green

**Triangle Tests**

- Shoot thin – Early Harvest
- No Shoot-thin Late Harvest

---

CE = control, early harvest, CL = control, late harvest
STE = shoot thinned, early harvest, STL = shoot thinned, late harvest
Foch Triangle Tests

- Shoot thinned late harvest preferred over Control late harvest
- Shoot thinned late harvest preferred over Shoot thinned early harvest

Maintaining revenue per acre in Foch vineyard:

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Yield (t/a)</td>
<td>4.1</td>
<td>3.3</td>
<td>7.0</td>
<td>5.3</td>
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<tr>
<td>Rev. per acre</td>
<td>$2,460</td>
<td>-</td>
<td>$4,662</td>
<td>-</td>
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<tr>
<td>Add. prod. costs/acre</td>
<td>$0</td>
<td>$54</td>
<td>$0</td>
<td>$54</td>
</tr>
<tr>
<td>Add. prod. costs/ton</td>
<td>$0</td>
<td>$16.36</td>
<td>$0</td>
<td>$10.18</td>
</tr>
<tr>
<td>Req. price/ton</td>
<td>$600</td>
<td>$761</td>
<td>$666</td>
<td>$890</td>
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<tr>
<td>Add'l Cost/Btl (can make 60cs/ton)</td>
<td>$0</td>
<td>$0.22</td>
<td>$0</td>
<td>0.31</td>
</tr>
</tbody>
</table>

Table 2. Economic break-even analysis of cluster thinning in Riesling, 2008.

<table>
<thead>
<tr>
<th>Clusters (shoot)</th>
<th>Control (2-5+)</th>
<th>High (2.0)</th>
<th>Medium (1.5)</th>
<th>Low (1.0)</th>
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</thead>
<tbody>
<tr>
<td>Cost/acre</td>
<td>$2,400</td>
<td>$2,563</td>
<td>$2,580</td>
<td>$2,595</td>
</tr>
<tr>
<td>Yield T/A</td>
<td>5.5</td>
<td>4.4</td>
<td>3.3</td>
<td>2.3</td>
</tr>
<tr>
<td>Price/ton</td>
<td>$1,750</td>
<td>$2,223</td>
<td>$2,964</td>
<td>$4,275</td>
</tr>
<tr>
<td>Net revenue/acre</td>
<td>$7,225</td>
<td>$7,225</td>
<td>$7,225</td>
<td>$7,225</td>
</tr>
<tr>
<td>Add'l S/bottle (60cs/ton)</td>
<td>$0.66</td>
<td>$1.69</td>
<td>$3.51</td>
<td></td>
</tr>
</tbody>
</table>
Benefits: Cluster and Shoot thin Flavors

J. Vanden Heuvel Sensory Evaluations

- Marechal Foch:
  - ST wine significantly different than control in 2007 by 24-member sensory panel
- Riesling Cluster Thinning
  - Sommeliers: Wines different, preference varied.
- Leon Millot (shoot thin) (side by side, informal):
  - Shoot thin + No ST 'different'
  - 60% preferred ST, 40% preferred No ST

How does this relate to $$$??

Measureable Benefits

shoot and cluster thinning

GROWER:
1. I can meet buyer (winery) specs and sell my crop (Y/N)
2. I can better control diseases
3. Easier to harvest fruit
4. Charge more for grapes (grower)
QUALITY:
1. Higher brix (+ better quality?)
2. Better color, structure, tannins?
3. Reduce variability in fruit
4. Flavors better (varietal character, etc.)

Winery: I can:
1) charge more
2) sell more
3) market better
4) repeat sales

Vignoles – VSP vs Top Wire Cordon

VSP – Shoot thin

VSP – No shoot thin

TWC – Shoot thin

TWC – no shoot thin

VSP - thinned

VSP unthinned

TWC thinned

TWC unthinned
Training system and Fruit Rots

Total Rot (Botrytis + Sour), 9/19

Effects of training system and canopy manipulations were additive:

- With no canopy manipulation (control), effect of going from TW to VSP was modest; 20% reduction in average % rot.
- Within VSP, thinning shoots and removing clusters reduced rot by 40% relative to the check.
- Going from TW to VSP and thinning shoots + removing clusters reduced rot by 52% relative to the TW check.

Spray Coverage & Cluster Exposure

- Air movement
- Drying
- Better Spray Coverage

Viticulture, enology and marketing for cold-hardy grapes

Annual Growing Costs/Acre

Source: Gerald White "Cost of Establishment of V. vinifera in Finger Lakes 2010"

V. Vinifera Annual Growing Costs

<table>
<thead>
<tr>
<th>Item</th>
<th>Cost</th>
<th>% of Total</th>
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</thead>
<tbody>
<tr>
<td>VSP</td>
<td>$2,210</td>
<td>100%</td>
</tr>
<tr>
<td>Equipment</td>
<td>$419</td>
<td>19%</td>
</tr>
<tr>
<td>Materials</td>
<td>$429</td>
<td>19%</td>
</tr>
<tr>
<td>Labor</td>
<td>$1,362</td>
<td>62%</td>
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<tr>
<td>Total</td>
<td>$2,210</td>
<td>100%</td>
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Annual Growing Costs: $2,210
Yield and Gross Receipts

**Vertical Shoot Positioning**

<table>
<thead>
<tr>
<th>Tons</th>
<th>2.0</th>
<th>2.5</th>
<th>3.0</th>
<th>3.5</th>
<th>4.0</th>
<th>4.5</th>
<th>5.0</th>
<th>5.5</th>
<th>6.0</th>
<th>6.5</th>
<th>7.0</th>
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<tbody>
<tr>
<td>Gross Receipts at different prices/ton</td>
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<td>5100</td>
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<td>5700</td>
<td>6200</td>
<td>6700</td>
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</tbody>
</table>

Annual Growing Costs = $2200
Fixed Costs = $1400/Acre
Total Costs = $3600/Acre
Watertown Vineyard Plots

- Training Systems
  - VSP
  - Top Wire Cordon
  - Umbrella Kniffen

- Crop Level
  - Frontenac (Cluster Thin)
  - La Crescent (Nature)

Frontenac

- Yield components?
  - HWC > UK > VSP
  - Cluster Number (p = 0.10)
  - Berries/Cluster (p = 0.051)

Marquette

- Yield components:
  - Cluster number (p = 0.06)
  - Cluster weight (p = 0.05)
  - Number of berries/cluster (p = 0.08)
  - Number of clusters/node (p = 0.08)

Training System, Canopy Management and Quality

- Consider Costs and Benefits
  - Shoot and cluster thinning reduce crop increase labor requirements
  - Fruit chemistry effects: often modest
  - Sensory quality and $: Hard to quantify
  - Tonnage sometimes ‘trumps’ ‘quality gain’
  - Other practices may have equivalent impact
  - Harvest date, winemaking practices

Viticulture, enology and marketing for cold-hardy grapes

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