Vine Capacity

• Potential to produce carbohydrates to meet the demands of fruit production and vegetative growth
  – Based on effective leaf area (need \( \sim 10-12 \text{ cm}^2 \) per gram of fruit)
  – Goal: Maximum yields of highest quality fruit without sacrificing vine size (capacity).

• Dormant pruning weight is a very good indicator of leaf area and is easier to measure
  – Weight of one-year-old canes = “Vine Size” or “pruning wt”

• Rule of thumb: Yield:vine size ratio (aka Crop load) should range from 5-10 for vinifera, 8-12 for American and hybrid varieties (10 is a good starting point)
Determining Vine Capacity

- Leaf area / fruit ratio should be approx. 10 cm²/g
  - 1 m² per kg or 0.4 m² per lb
  - at 8 ft (2.4 m) spacing and 5 ft (1.5 m) height vines have 7.2 m² of canopy and can support up to ~25 lb of fruit (7 tons/a)

- Decrease in Leaf area / fruit ratio:
  - Reduced soluble solids, delayed ripening
  - Reduced flavor and aroma

- Increase in Leaf area / fruit ratio:
  - No increase in soluble solids, etc.
  - Possible shading problems ~ poor fruit quality
Big Vine Theory

• Bigger the vine, more it can produce.
  – Leave more buds to “balance” yield to capacity
  – More buds = more shoots = more clusters
  – More shoots = higher shoot density thus more shading unless vine spacing is increased
  – How far apart should vines be spaced???

• Standard spacing is 6-8 ft between vines by 9-11 ft between rows for hybrids and juice grapes (550-700 vines/a)
A Really Big Vine
The Winkler Vine, UC-Davis
Another Really Big Vine
The Mother Vine, Roanoke Island, NC

Also visit Clinton, IN to see the wild riparia vine at the old store/winery.
Balanced Vine Concept

• Fruit production and shoot growth compete for available carbohydrates
  – Fruit growth and shoot growth are inversely related
    • As fruit production increases, shoot growth decreases
    • Lack of fruit production will result in excessive shoot growth (e.g. following frosts)
Pruning Severity to Manage Crop Load

• First step toward balancing vines
• Appropriate level is variety dependent
• Balanced Pruning
  – Use a formula to determine how many buds to retain based on the pruning weight
• Balanced cropping
  – Use the crop load ratio to decide how much fruit to retain per vine
How much to prune? How much to leave?

“Balanced Pruning” determines the appropriate number of nodes to retain.
How much to remove?

Remove about 90-95% of the previous season’s growth
Assumption: One bud = one shoot
Balanced Pruning

- Number of buds retained depends on “vine size”
- Vine size = weight of 1-year-old cane prunings
- Use of “Pruning Formula” for specific variety

<table>
<thead>
<tr>
<th>Grape Variety</th>
<th>Pruning Formula</th>
<th>Cluster Thinning</th>
</tr>
</thead>
<tbody>
<tr>
<td>American</td>
<td>30 + 10</td>
<td>No</td>
</tr>
<tr>
<td>French Hybrids</td>
<td>20 + 10, 15 + 5</td>
<td>Yes/No/Maybe</td>
</tr>
<tr>
<td>New Hybrids</td>
<td>20 + 20?</td>
<td>Yes/No/Maybe</td>
</tr>
<tr>
<td>Vinifera</td>
<td>20 + 20</td>
<td>Yes/No/Maybe</td>
</tr>
</tbody>
</table>
Example of Balanced Pruning

• Pruning Formula: 30 + 10
  – Leave 30 nodes ("count buds") for first pound of canes removed plus an additional 10 for each additional pound

• Pruning wt = 1 lb – leave 30 nodes
• Pruning wt = 2 lb – leave 40 nodes
• Pruning wt = 2.5 lb – leave 45 nodes
• Pruning wt = 3 lb – leave 50 nodes
Reality of Balance Pruning Approach

• Unfortunately, it is more complicated
• Only works well on American-type varieties
• Hybrids tend to be more fruitful
  – More clusters per shoot
  – More shoots per “count” node
• Hybrids require more management to maintain “vine balance”
  – Shoot thinning
  – Cluster thinning
One shoot per node
Proliferation of non-count shoots
Non-count shoots
Problem with balanced pruning formulas:

– On small vines they tend to suggest a very low number of shoots, which would produce far below the optimum leaf area for the vine. (e.g. 5+10 for Seyval)
– They don’t take into account non-count buds

A better approach to balancing vines

– Instead of applying a formula to determine number of buds, why not leave enough shoots to fill the trellis space then use a formula to adjust the number of clusters to meet a targeted “crop load” value?
– That will help maximize “vine capacity” (leaf area) without causing vine imbalance.
Using Balanced Cropping Approach
(Target Crop Load)

1. Prune and thin to 5-6 shoots per foot of row (40-50 shoots per vine at 8 ft vine spacing)

2. Use long-term average cluster weight data to calculate number of clusters needed for yield that will give a desired “crop load ratio” based on “vine size” data*. (See HO-221 Grape Varieties for Indiana)
   *Alternately can estimate cluster weight 60 DAB

3. Thin clusters to appropriate number

Required data:
- Vine size (pruning weight)
- Vine yield (crop weight)
- Cluster weight (number of clusters per vine)
At 60 DAB, fruit is approximately ½ the weight it will be at harvest.
## Variety Performance over 12 years
Southwest Purdue Ag Center

<table>
<thead>
<tr>
<th>Variety</th>
<th>Yield (lb)</th>
<th>Vine Size (lb)</th>
<th>Crop load ratio</th>
<th>Cluster wt (lb)</th>
<th>Clusters per vine</th>
<th>Clusters for crop load ratio =10</th>
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</thead>
<tbody>
<tr>
<td>Chambourcin</td>
<td>19</td>
<td>1.1</td>
<td>17</td>
<td>0.41</td>
<td>47</td>
<td>24</td>
</tr>
<tr>
<td>Chardonel</td>
<td>17</td>
<td>1.0</td>
<td>17</td>
<td>0.39</td>
<td>44</td>
<td>26</td>
</tr>
<tr>
<td>Seyval</td>
<td>22</td>
<td>1.0</td>
<td>22</td>
<td>0.45</td>
<td>49</td>
<td>22</td>
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<tr>
<td>Norton</td>
<td>17</td>
<td>3.2</td>
<td>5</td>
<td>0.19</td>
<td>90</td>
<td>168</td>
</tr>
<tr>
<td>Foch</td>
<td>24</td>
<td>2.2</td>
<td>11</td>
<td>0.21</td>
<td>115</td>
<td>105</td>
</tr>
<tr>
<td>Frontenac</td>
<td>12</td>
<td>1.2</td>
<td>10</td>
<td>0.29</td>
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Chardonel 17 1.0 17 0.39 44 26
Seyval 22 1.0 22 0.45 49 22
Norton 17 3.2 5 0.19 90 168
Foch 24 2.2 11 0.21 115 105
Frontenac 12 1.2 10 0.29 41 41

These varieties are over cropped. CL > 10. Need to reduce # clusters. Note large cluster size.
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#### Southwest Purdue Ag Center

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Norton is under cropped. CL< 8. Need to leave more buds to get more clusters.
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</tbody>
</table>

Foch and Frontenac are cropped appropriately. CL = 10 despite large difference in vine size and yield.
## Variety performance over 6 yrs at Lafayette

<table>
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<th>Vine Size (lb)</th>
<th>Crop load ratio</th>
<th>Cluster wt (lb)</th>
<th>Clusters per vine</th>
<th>Clusters for crop load ratio =10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cayuga White</td>
<td>24</td>
<td>1.0</td>
<td>24</td>
<td>.32</td>
<td>75</td>
<td>31</td>
</tr>
<tr>
<td>Corot Noir</td>
<td>18</td>
<td>1.2</td>
<td>16</td>
<td>.31</td>
<td>58</td>
<td>39</td>
</tr>
<tr>
<td>Frontenac</td>
<td>12</td>
<td>0.9</td>
<td>13</td>
<td>.17</td>
<td>71</td>
<td>53</td>
</tr>
<tr>
<td>LaCrescent</td>
<td>12</td>
<td>1.3</td>
<td>9</td>
<td>.18</td>
<td>67</td>
<td>72</td>
</tr>
<tr>
<td>Noiret</td>
<td>15</td>
<td>2.5</td>
<td>5</td>
<td>.31</td>
<td>48</td>
<td>80</td>
</tr>
<tr>
<td>Traminette</td>
<td>14</td>
<td>2.2</td>
<td>6</td>
<td>.22</td>
<td>64</td>
<td>100</td>
</tr>
</tbody>
</table>

Note wide range of CL ratios. High vigor varieties like Noiret and Traminette are under cropped. Cayuga is an anomaly. Vine size is low due to fall dieback.
Which canes to retain?

- Select canes exposed to sun, located on outside of vine canopy
- Select canes with good wood maturation
  - Dark brown* periderm (*appropriate for variety)
  - Short to medium internodes (4” to 6”)
  - Cane diameter of 1/4” to 1/2”
- Select canes with less persistent laterals
Good Quality Canes
Poor Quality Canes

Shaded canes, poor color, winter killed
Summary

• Select an approach to “balanced cropping”
  – Balanced pruning
  – Target crop load
• Record important variables
  – Vine Size
  – Vine Yield
  – Cluster weight or number per vine
• Check results each year and adjust if necessary