Pruning, Training and Canopy Management of Grapevines in the Midwest

S. Kaan Kurtural
Dept. Horticulture
University of Kentucky
Grapevine morphology
Grapevine fruiting characteristics

- Fruiting shoots are born on one-year old dormant buds
- Because of this character trait, we prune to replace the fruiting wood each year
- Pruning results in removal of 80 – 90% of the dormant canes per year
Dormant buds

Newly Emerging Shoot
Over wintering Compound Bud

Courtesy: M. Goffinet Cornell University
Periderm and Bud Acclimation in Shoots

Periderm Development and Bud Acclimation

MID SEPTEMBER

Mild Supercooling  No Supercooling

LATE SEPT.—EARLY OCT.

Deeper Supercooling  Supercooling  Mild Supercooling  No Supercooling

LATE OCTOBER

Deep Supercooling  Weak or No Supercooling

Die-back

Courtesy: M. Goffinet Cornell University
**Terminology**

- **Pruning**: removal of plant parts for horticultural objectives
  - Controls size and form of the grapevine
  - Optimizes the production potential of the grapevine
  - Maintains the balance between vegetative and fruiting growth

- **Training**: arranging the parts of the grapevine on the trellis to develop a structure that
  - Optimizes the interception of sunlight
  - Is economical to establish and maintain
Effects of pruning on the vine

- 1) A vine can only ripen a certain amount of clusters in a given season
- 2) Pruning has a depressing effect on the vine
- 3) Capacity of the vine directly related to number of shoots retained
- 4) Production of crop depresses vine capacity
- 5) Shoot vigor is indirectly related to cluster number
- 6) Bud fruitfulness is indirectly related to shoot vigor
- 7) Old growth (a large cane, arm) can carry more fruit vs. newly established cordon
Pruning and Training young grapevines

- In Midwestern United States, young grapevines trained to a double trunk
- If one trunk is killed, the other trunk will provide some production
Pruning and Training
young vines

Post First Season

Post Second Season

Post Third Season
Pruning and Training young vines

- From the 1\textsuperscript{st} to the end of the 3\textsuperscript{rd} season, pruning and training practices are the same for all training systems.
Single curtain training systems

Bi-lateral High Cordon
Suitable for cultivars with trailing
Or
Downward Growth Habit

Bi-lateral Low Cordon
Suitable for cultivars with Upright Growth Habit
Growth Habits

- **Downward**
  - American grapes
  - Some of the hybrids

- **Upright and Semi-upright**
  - Vinifera cultivars
  - Some of the hybrids
  - Chardonel
  - Seyval blanc
  - Vignoles
  - Traminette
Growth habit examples

Drooping / Trailing

American and many hybrids

Upright

European and some hybrids
First dormant pruning
(Spring of 2\textsuperscript{nd} Year)

- Goal is to establish the trunk:
  - If cane did not reach trellis prune back to wood 3/8” OR
  - Prune back to two buds
  - Tie to bamboo stake

- STRAIGHT TRUNKS!
Goal is to establish the CORDON and increase ROOT AREA
- Train shoots onto the wire
- Cut suckers at the floor
- Remove any clusters that are developing
2nd Dormant Pruning (Spring of 3rd Year)

- Goal is to establish FRUITING CORDON
  - Select best spurs based on position, vigor
  - Prune back any lateral canes to one-node
  - The vine should fill allotted space in this year
3rd Growing Season

- Rub off any shoots developing on the trunk
- Prune off any suckers developing
- Time to think about Balanced Pruning!
Pruning Mature Vines

Before

After

Illustrations from:
Ohio State Univ.
Bulletin 815, Agdex 231
VSP - Before
VSP - After
Balanced Pruning

- Maintains a balance between vegetative and reproductive production
- One year old dormant pruning weight determines how many buds to retain for the upcoming year
Single high-wire - Before
Single high-wire - After
Background of Balanced Pruning

- Pruning weight = Leaf area
- Leaf area required to ripen unit of fruit
  - Too many clusters per unit leaf area
  - Too few clusters per unit leaf area
Assessing Vine Efficiency

- Crop load (Practical)
  - Yield ÷ Prunings (range 5 – 15)
- Leaf area : Fruit (Hardly practical)
  - Leaf area ÷ Yield (range 8 – 12)
Relationship between Crop Load and Leaf area: Fruit

Optimum Crop Load for the Lower Midwest

\[ R = -0.50 \]
\[ p < 0.0001 \]
Spur Pruning

**ADVANTAGES**
- High % bud-break and uniform
- Less labor intensive
- Use wider spacing
- Ease of mechanization

**DISADVANTAGES**
- Varieties with low bud fruitfulness at base
Cane Pruning

- ADVANTAGES
  - Mid-cane buds (4 – 12) fruitful in some varieties like ‘Concord’, ‘Sultana’

- DISADVANTAGES
  - Labor intensive
  - Low % bud-break and not uniform
  - Use vine spacing < 6’
  - Not easily mechanized
What do you mean by Balanced Pruning and its Formulae?

- The number of buds to retain for the 1\textsuperscript{st} pound one-year old of prunings collected

\[ 15 + 10 \]

- The number of nodes to retain for additional pound of one-year old prunings
- If wt of prunings > 4 lbs do not retain additional nodes
Steps in Balanced Pruning

- Rough prune to 5 - node spurs
- Measure the weight of prunings
- Adjust the number of nodes to retain on vine according to the Balanced Pruning Formula for the cv.
What are the ideal spurs to retain?

- Avoid bull canes (thick diameter)
- Should be pencil diameter
- Tan to brown in color
- AVOID weak and spindly canes that have short internodes
Applying the Balanced Pruning formula (20 + 10)

<table>
<thead>
<tr>
<th>Wt of prunings (lb)</th>
<th>No. of nodes retained</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 (20 + 10)</td>
<td>20</td>
</tr>
<tr>
<td>2 (20 + 10)</td>
<td>30</td>
</tr>
<tr>
<td>3 (20 + 10 + 10)</td>
<td>40</td>
</tr>
<tr>
<td>4 (20 + 10 + 10 + 10)</td>
<td>50</td>
</tr>
</tbody>
</table>
Compensating for Winter Injury

- Macroclimate is continental in nature
- Inspect buds before pruning
- 100 sample buds from all varieties grown
- Slice thru buds with a razor and examine for PRIMARY BUD INJURY
Compensating for Winter Injury with Balanced Pruning

- **0 % to 20 %**
  - No compensation for injury
- **20% to 80% of injury**
  - Adjust accordingly
- **>80% injury**
  - Keep pruning to a minimum! You might have reestablish cordons or trunks
Case for French-American hybrids

- Many fruitful shoots from non-count positions
- Therefore balanced pruning does not adequately control cropping levels
Cluster thinning adjusts

- Cropping to achieve a better balance between vegetative capacity and fruiting in French-American hybrids (fruiting on non-count shoots)
Rule of thumb

- Small clustered cultivars
  - No need for cluster thinning
- Large clustered cultivars and varieties with fruitful base buds
  - One cluster per shoot
- Timing is critical
  - Most benefit if applied pre-bloom
## Pruning formulae and Cropload Windows for various cultivars grown in Lower Midwest

<table>
<thead>
<tr>
<th>Cultivar</th>
<th>Nodes 1st lb</th>
<th>Nodes 2nd lb</th>
<th>Cropload</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small clustered cvs.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M. Foch</td>
<td>20</td>
<td>20</td>
<td>5-10(8-14)</td>
</tr>
<tr>
<td>L. Millot</td>
<td>20</td>
<td>20</td>
<td>5-10(8-14)</td>
</tr>
<tr>
<td>Vignoles</td>
<td>20</td>
<td>10</td>
<td>8-12</td>
</tr>
<tr>
<td>Norton</td>
<td>30</td>
<td>10</td>
<td>8-14</td>
</tr>
<tr>
<td>Cab. Franc</td>
<td>20</td>
<td>10</td>
<td>5-10</td>
</tr>
</tbody>
</table>
### Pruning formulae and Cropload Windows for various cultivars grown in Lower Midwest

<table>
<thead>
<tr>
<th>Cultivar</th>
<th>Nodes 1(^\text{st}) lb</th>
<th>Nodes 2(^\text{nd}) lb</th>
<th>Cropload</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vidal</td>
<td>10 (20(*))</td>
<td>10</td>
<td>10 - 13</td>
</tr>
<tr>
<td>Traminette</td>
<td>20</td>
<td>20</td>
<td>10 - 13</td>
</tr>
<tr>
<td>Chardonel</td>
<td>20</td>
<td>20</td>
<td>12 - 15</td>
</tr>
<tr>
<td>NY 70</td>
<td>20</td>
<td>20</td>
<td>12 - 15</td>
</tr>
<tr>
<td>NY 73</td>
<td>20</td>
<td>20</td>
<td>12 - 18</td>
</tr>
</tbody>
</table>

* On rootstock

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**Medium clustered cvs.**
# Pruning formulae and Cropload Windows for various cultivars grown in Lower Midwest

<table>
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<tr>
<th>Cultivar</th>
<th>Nodes 1\textsuperscript{st} lb</th>
<th>Nodes 2\textsuperscript{nd} lb</th>
<th>Cropload</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Large clustered cvs.</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chambourcin</td>
<td>20</td>
<td>20</td>
<td>10 - 13</td>
</tr>
<tr>
<td>Chancellor</td>
<td>20</td>
<td>20</td>
<td>12 - 18</td>
</tr>
<tr>
<td>Seyval</td>
<td>10(20*)</td>
<td>10</td>
<td>12 - 15</td>
</tr>
<tr>
<td>Villard blanc</td>
<td>20</td>
<td>20</td>
<td>12 - 18</td>
</tr>
<tr>
<td>NY 76</td>
<td>20</td>
<td>20</td>
<td>12 - 18</td>
</tr>
<tr>
<td>(* On rootstock)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
CAUTION

The preceding tables should be used only if

- Site well prepared
- Annual fertility program
- Well-drained soil
- Canopy management practiced
- Use of rootstock when appropriate
- Optimal perennial management
- Growers records retained
TRAINING SYSTEMS
Why we train the grapevine?

- The grape is a true vine
- In the wild the tendrils help it scavenge for light
- In cultured settings, various trellis systems to train and support the vine
Selecting a Training System

1) Site rank for VIGOR POTENTIAL
   - Low, Moderate, High
     ■ Soil
     ■ Rain

2) Variety rank for VIGOR POTENTIAL
   - Low, Moderate, High

3) Variety growth habit
   - Drooping/Trailing
   - Upright

4) Trellis cost

5) Equipment (tractor width, sprayer width etc.)

6) Vine spacing
Single curtain Bi-lateral High - Cordon

- Preferred for French-American hybrids, American cultivars for downward growth habit
- Spur – pruning (1-5 buds)
- MODERATE VIGOR cultivars!

**Advantages:**
- Economical
- Higher yield
- Better sunlight exposure
- Cold hardiness
- Less deer browsing (?)

**Disadvantages:**
- Some varieties too vigorous
Single curtain Bi-lateral High-Cordon

9’ to 10’
Single curtain Bi-lateral High-Cordon

FRUIT ZONE

Spurs or short canes

Training wire (optional)

6½'

36-48"
Single curtain Bi-lateral Low-Cordon (VSP)

- Preferred for European cultivars
- Most common system in the world
- For LOW VIGOR cultivars
- Advantages
  - Ease of pruning
  - Ease of mechanization
  - Improved fruit composition
- Disadvantages
  - Trellis cost
  - Reduced yield
  - In high vigor sites, shading in the Fruit Zone, Hedging Required
Single curtain Bi-lateral Low-Cordon (VSP)
Geneva Double Curtain

- Preferred for vigorous and shy-bearing cultivars ('Concord, Norton, Traminette, Sultana, Perlette)
- Spur or cane pruning (cultivars dependent)

**Advantages**
- Increased yield (20% - 90%)
- Increased fruit composition

**Disadvantages**
- Cost of trellis
- In warm regions reduced fruit quality especially in white varieties
- Row spacing of at least 12’
Geneva Double Curtain
Geneva Double Curtain

Fruit Zone
Canopy Management
Canopy Management

- What is the CANOPY?
  - Shoot system
    - Stem + Leaves + Clusters
  - Length, Height, Width, Leaf area, Shoot Density
  - Shoot Density = No. of shoot per length of canopy or row run
What is CM?

- Modification of position or amount of leaves, shoots and fruit to achieve desired arrangement
Why CM? and its benefits

- Extra work for growers but has benefits
- Maximizing sunlight interception
- Further balance between shoot growth and fruit production
Benefits

- Increased air movement
  - Ameliorated drying time for rain, dew; thus less disease pressure
- Better spray penetration and disease control
- Improved fruit composition varietal character
- Increased bud fruitfulness
- Improved bud cold hardiness
Steps of CM

- There are 5 major steps of CM
- Growing season has an impact on CM
  - (dry summers 1999, 2002)
- Cultivars
- Grower experience
1) Shoot thinning (Suckering)

- Suckering trunks or cordons
- On the cordons, removal of unfruitful shoots
- Spacing of shoots evenly on the cordon: 4 to 6 shoots per foot of row
- With 8 foot vine spacing 32 to 48 shoots per vine (single canopy)
- Divided canopies: 64 – 96 shoots per vine (remember there are 2 feet of canopy for each foot of row!)
1) **Shoot thinning**

- **When?**
- **Trunk suckering**
  - 1” – 3” shoot length
- **Cordon**
  - 8” – 12” shoot length

- **In FROST PRONE AREAS WAIT TILL ALL DANGER OF FROST HAS PASSED!**
1) Shoot thinning

4 shoots per foot of canopy
1) Shoot thinning

8 shoots per foot of canopy
2) Shoot positioning

- Combing: Positioning shoots downward (High systems)
- Tucking: Positioning shoots upward (Low systems)
Shoot positioning on High Trellis systems

- Combing
Shoot positioning on Low Trellis Systems

- Vertical shoot positioning with upright growth habit
  - Tucking the canes between the catch wires
    - Mid-June every 15 days
3) Cluster thinning

- A must for large-clustered French-American hybrids
- Pre-bloom thinning
- Post fruit set-thinning
3) Cluster thinning

- Rule of thumb for post fruit-set cluster thinning
  - If shoot is < 12” long remove all clusters
  - If shoot 12” – 24 “ long retain one cluster
  - If shoot > 24” long retain 2 clusters
4) Shoot Hedging

- Cutting shoots back that grow beyond the allotted space
- Hedging for Low systems
- Skirting for High systems
4) Shoot hedging

- Remember: 12 leaves are needed to ripen one cluster so...
- DO NOT HEDGE BACK to the FRUIT ZONE!
- DO NOT HEDGE after VERAISON
4) Shoot Hedging

- Rules of thumb for hedging
  - For Low Systems: If Canopy Height is > 3.5'
  - For High Systems: If Canopy Height is > 5'
5) Leaf pulling

- WHY?
  - In the FRUITING ZONE for two goals
- Improve air movement and spray penetration
- Improve fruit and basal bud sun exposure
Where and what leaves do you pull?

- On ‘Shade’ side of canopy
  - If vineyards runs N - S
    - Pull leaves on E
  - If vineyard runs E - W
    - Pull leaves on N

- One to three leaves are removed around the basal clusters

- Well before veraison but NEVER after veraison to avoid sun burn
TRAMINETTE W/O LEAF PULLING
TRAMINETTE W/ LEAF PULLING
Questions