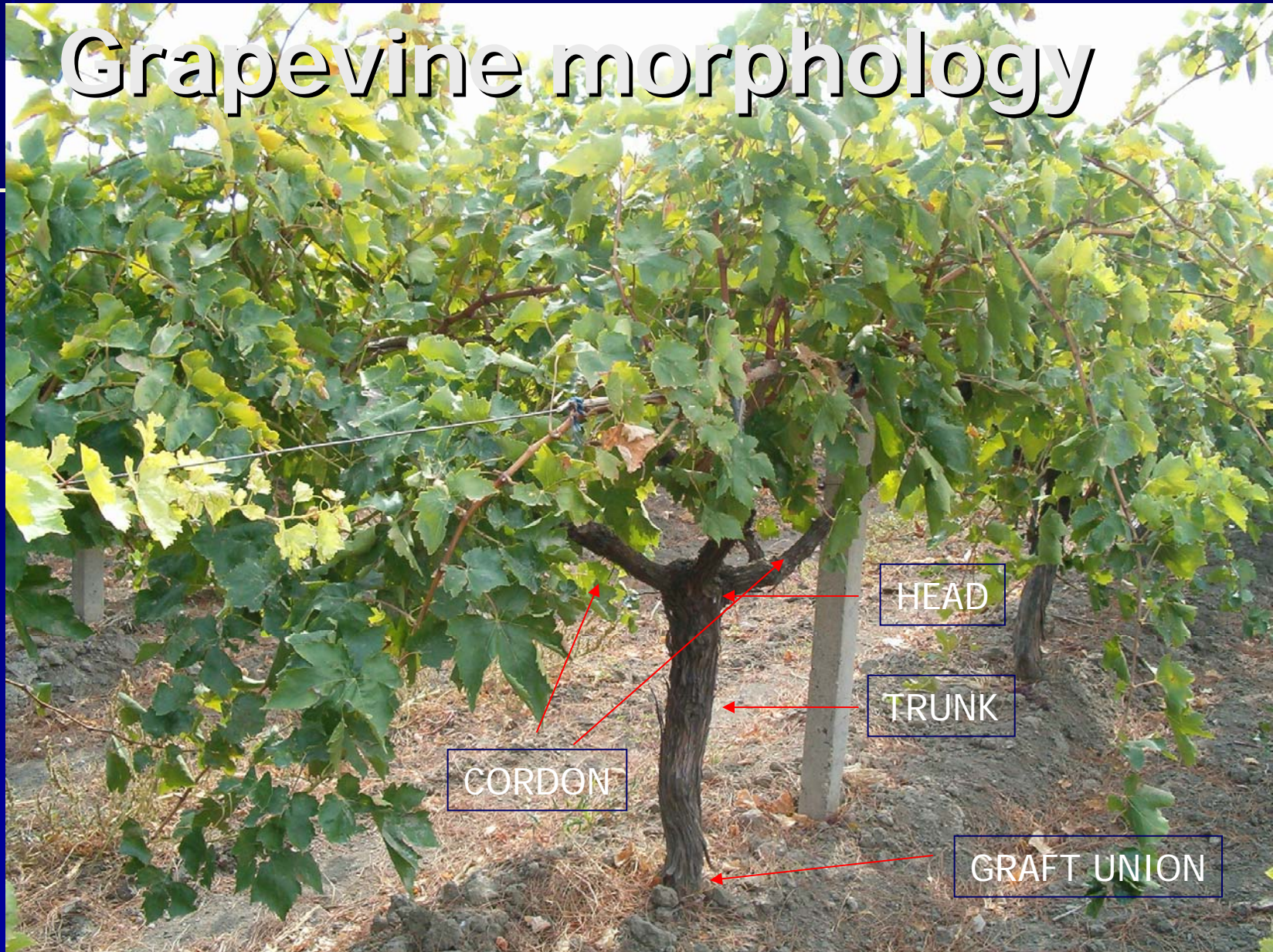


# Pruning, Training and Canopy Management of Grapevines in the Midwest

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

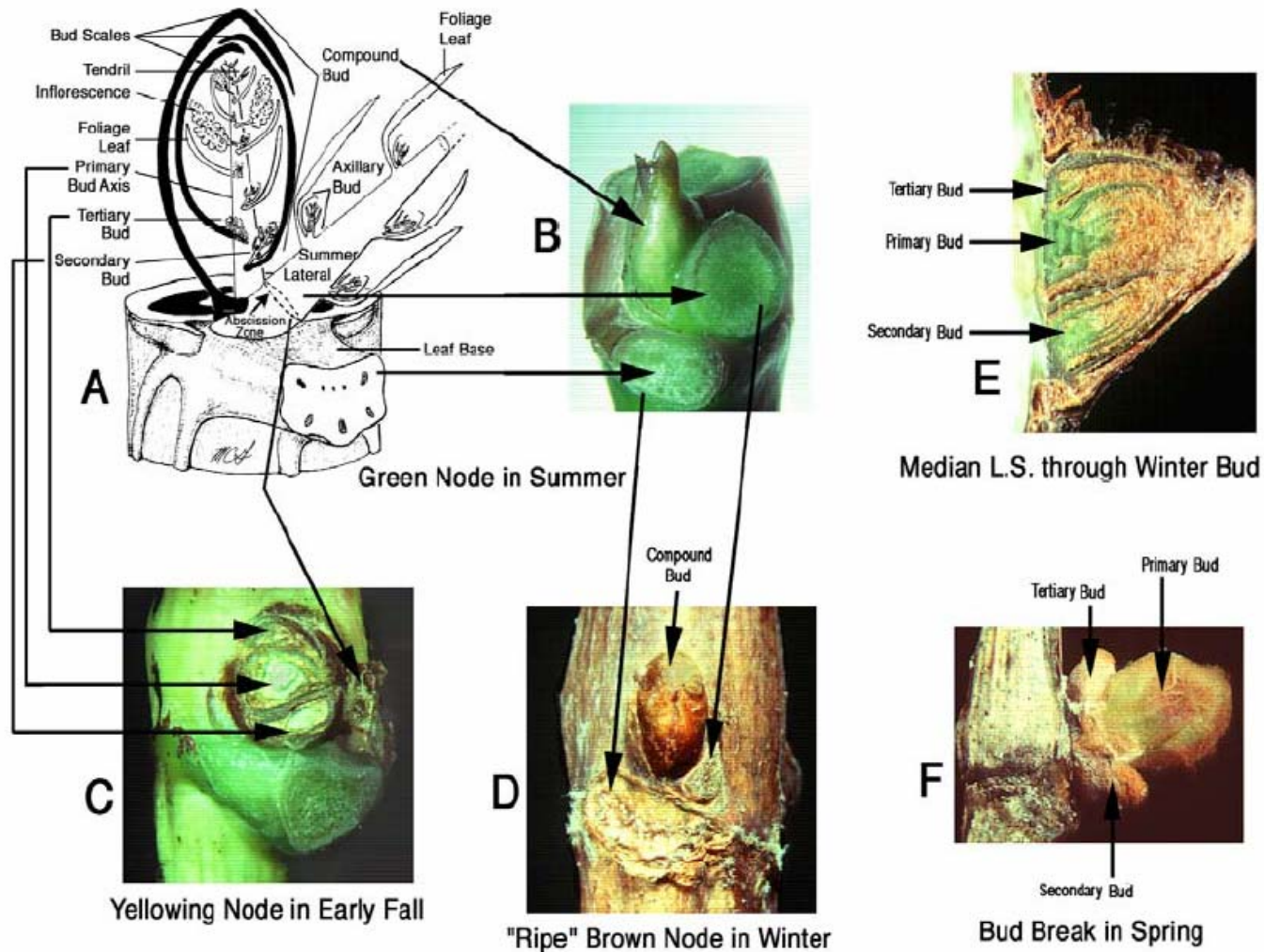


Newly Emerging Shoot



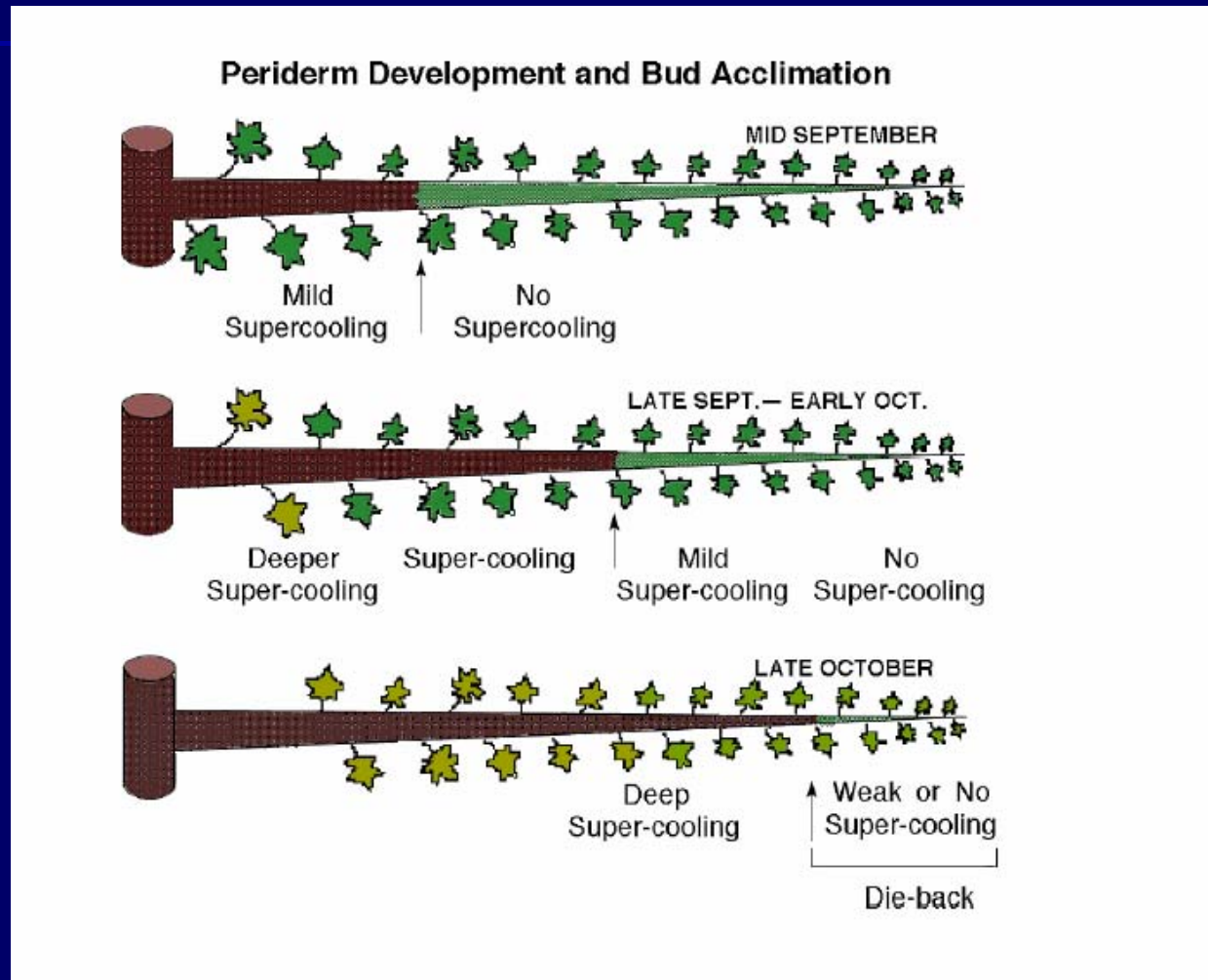


# Over wintering Compound Bud



Courtesy: M. Goffinet Cornell University

# Periderm and Bud Acclimation in Shoots



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

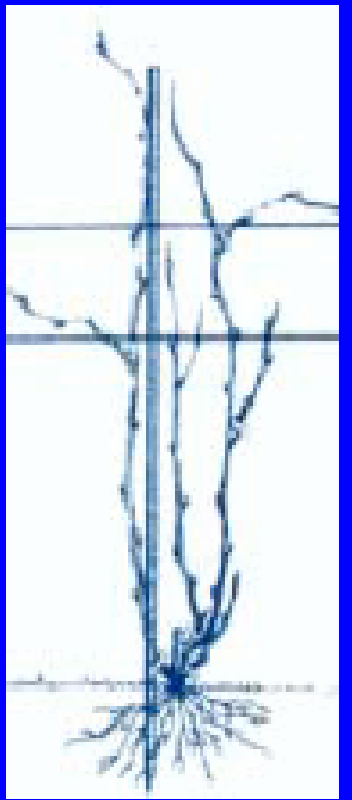
- 1) A vine can only ripen a certain amount of clusters in a given season
- 2) Pruning has a depressing effect on the vine
- 3) Capacity of the vine directly related to number of shoots retained
- 4) Production of crop depresses vine capacity
- 5) Shoot vigor is indirectly related to cluster number
- 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

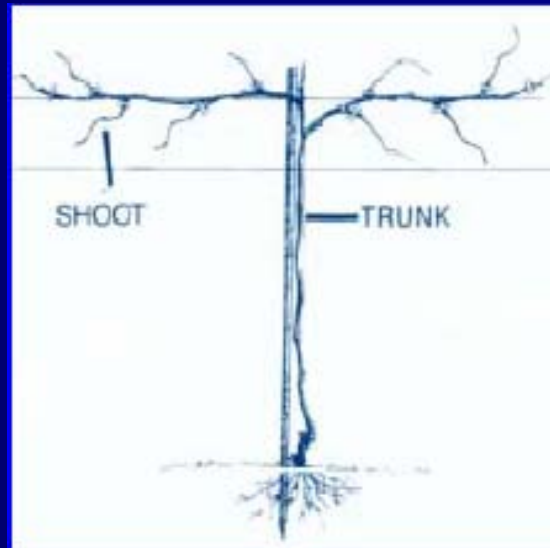
- In Midwestern United States, young grapevines trained to a double trunk
- If one trunk is killed, the other trunk will provide some production



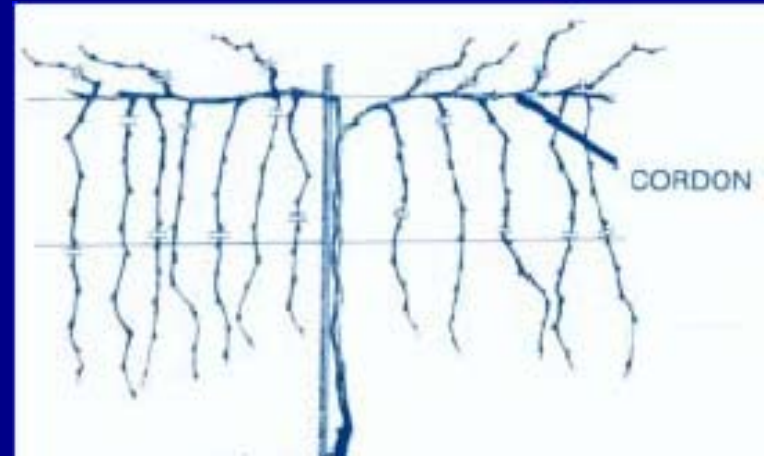
# Pruning and Training young vines



Post First Season



Post Second Season



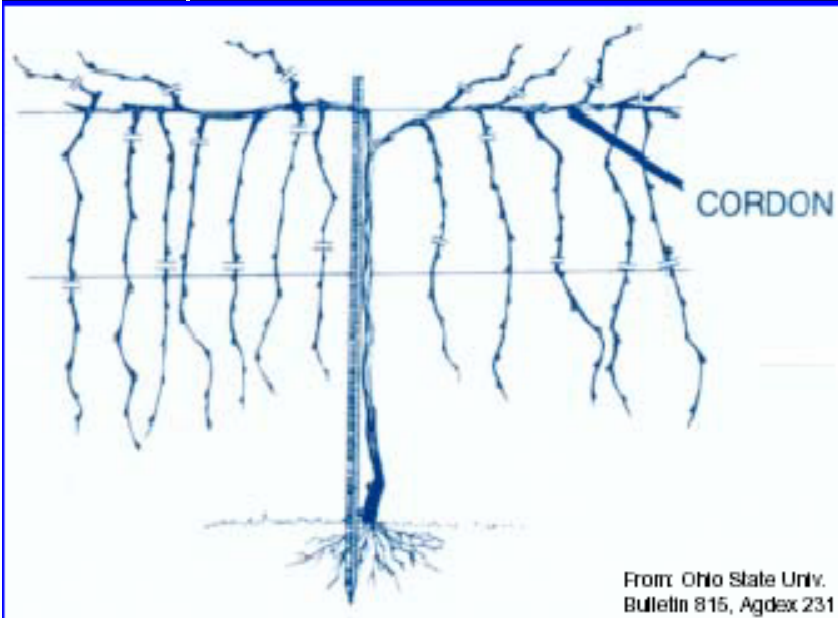
Post Third Season



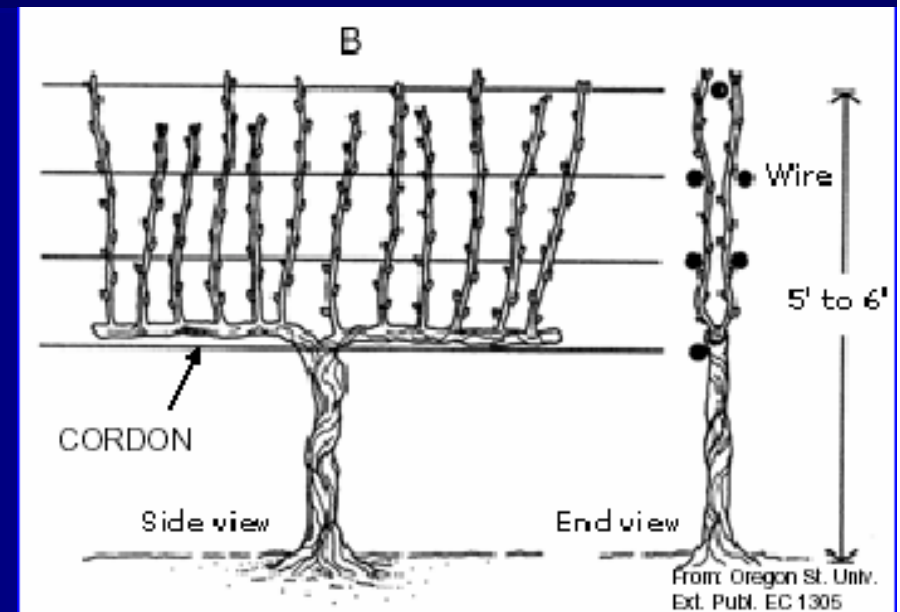
# Pruning and Training young vines

- From the 1<sup>st</sup> to the end of the 3<sup>rd</sup> 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

Upright



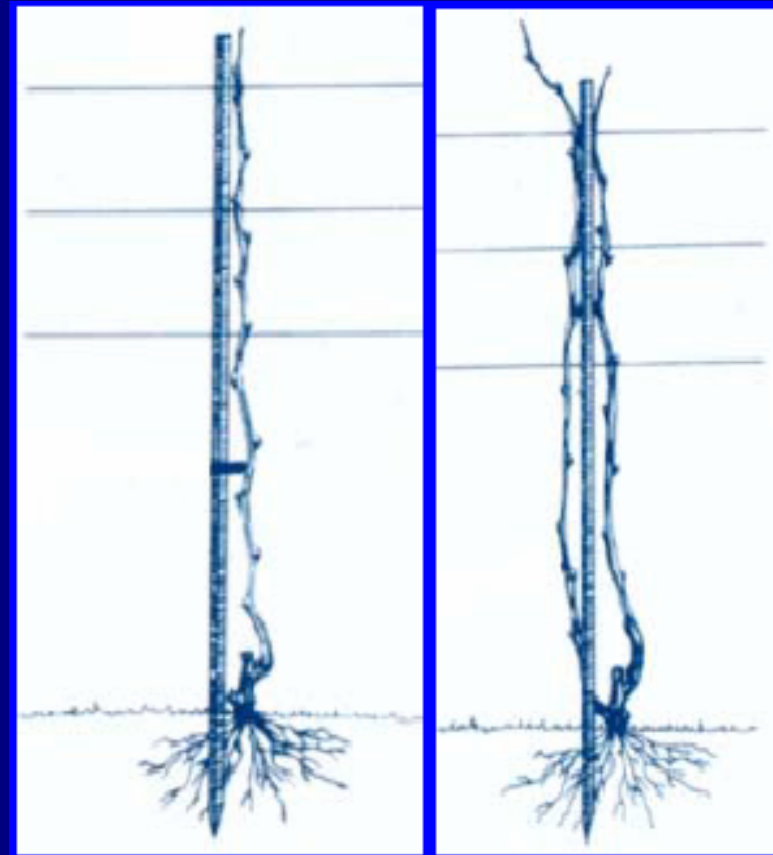
American and many hybrids



European and some hybrids

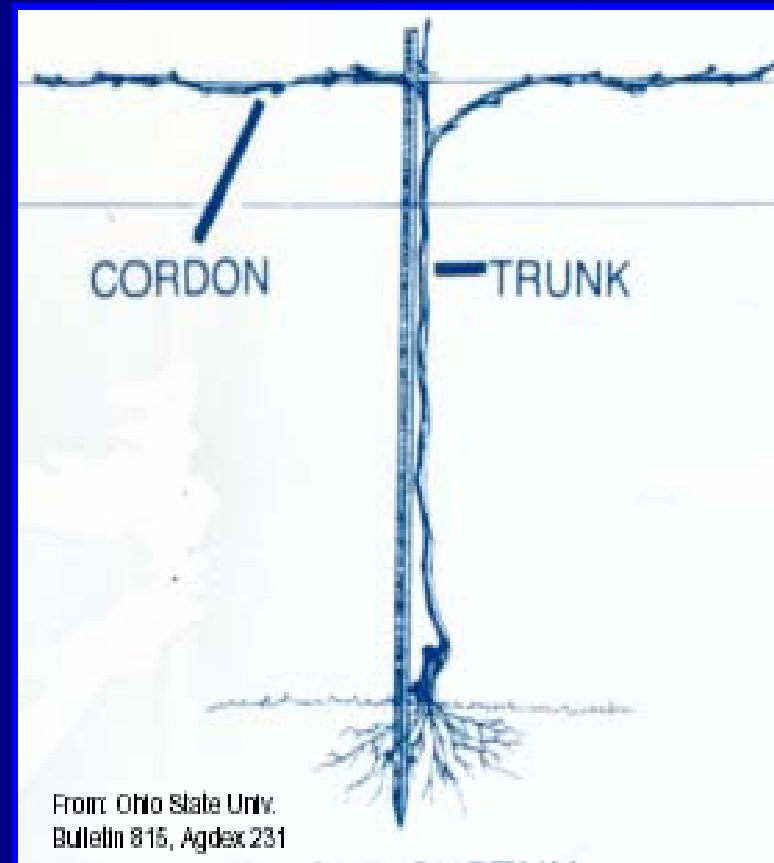
# First dormant pruning (Spring of 2<sup>nd</sup> Year)

- 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!



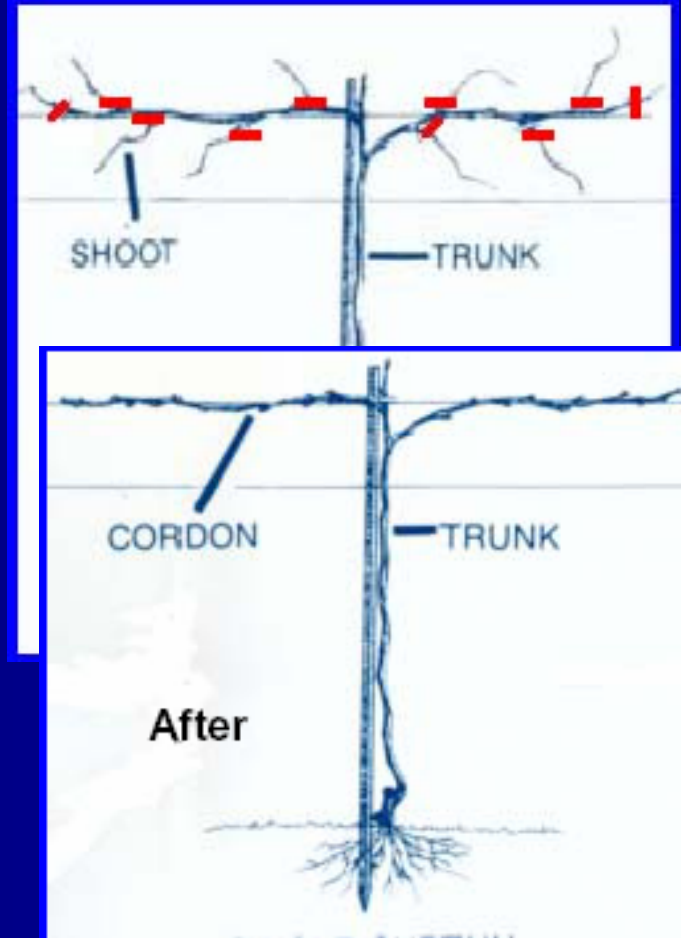
# 2<sup>nd</sup> Growing Season

- 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



# 2<sup>nd</sup> Dormant Pruning (Spring of 3<sup>rd</sup> 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



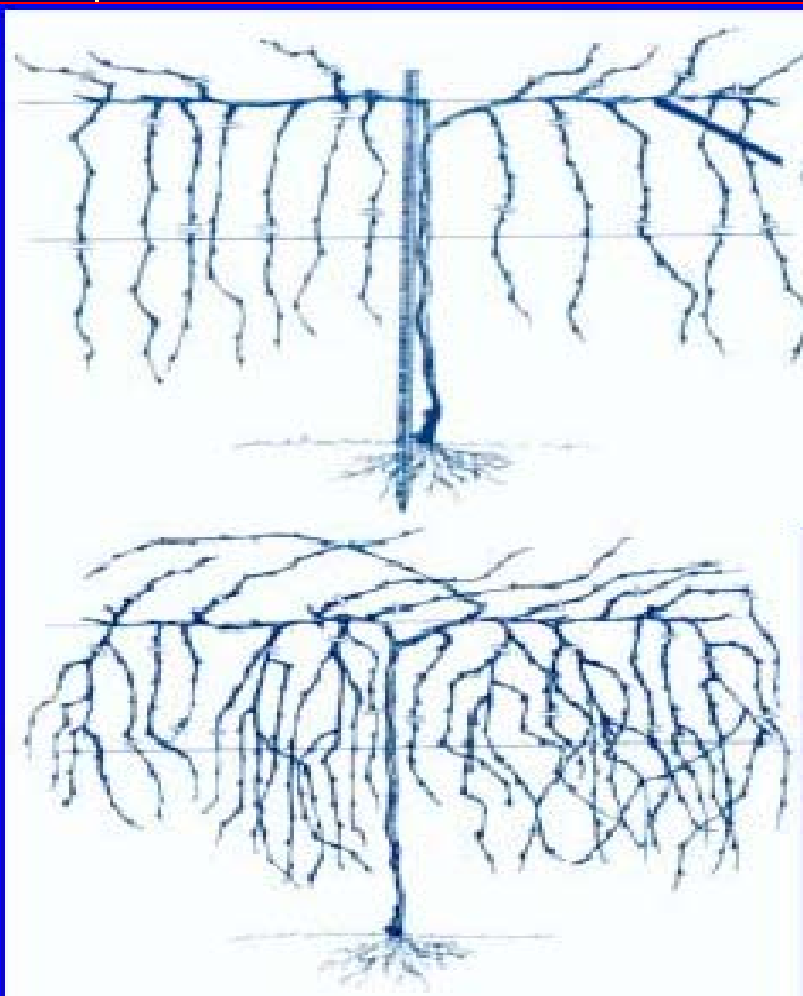
# 3<sup>rd</sup> Growing Season

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

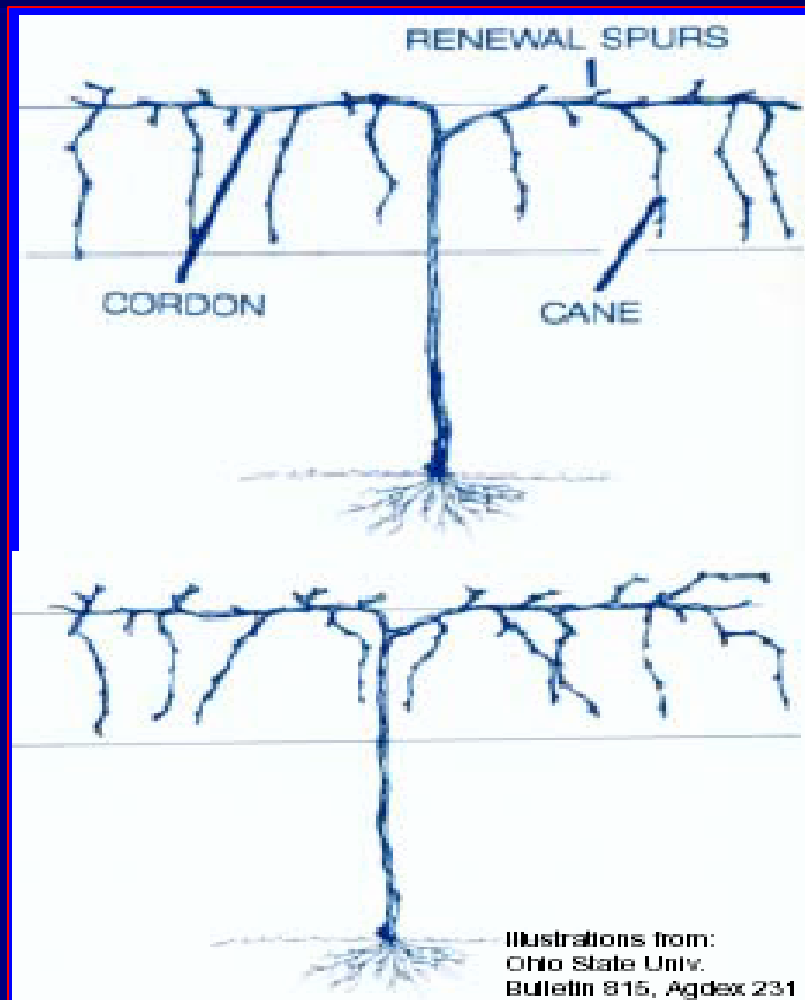


# Pruning Mature Vines

Before



After



# 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



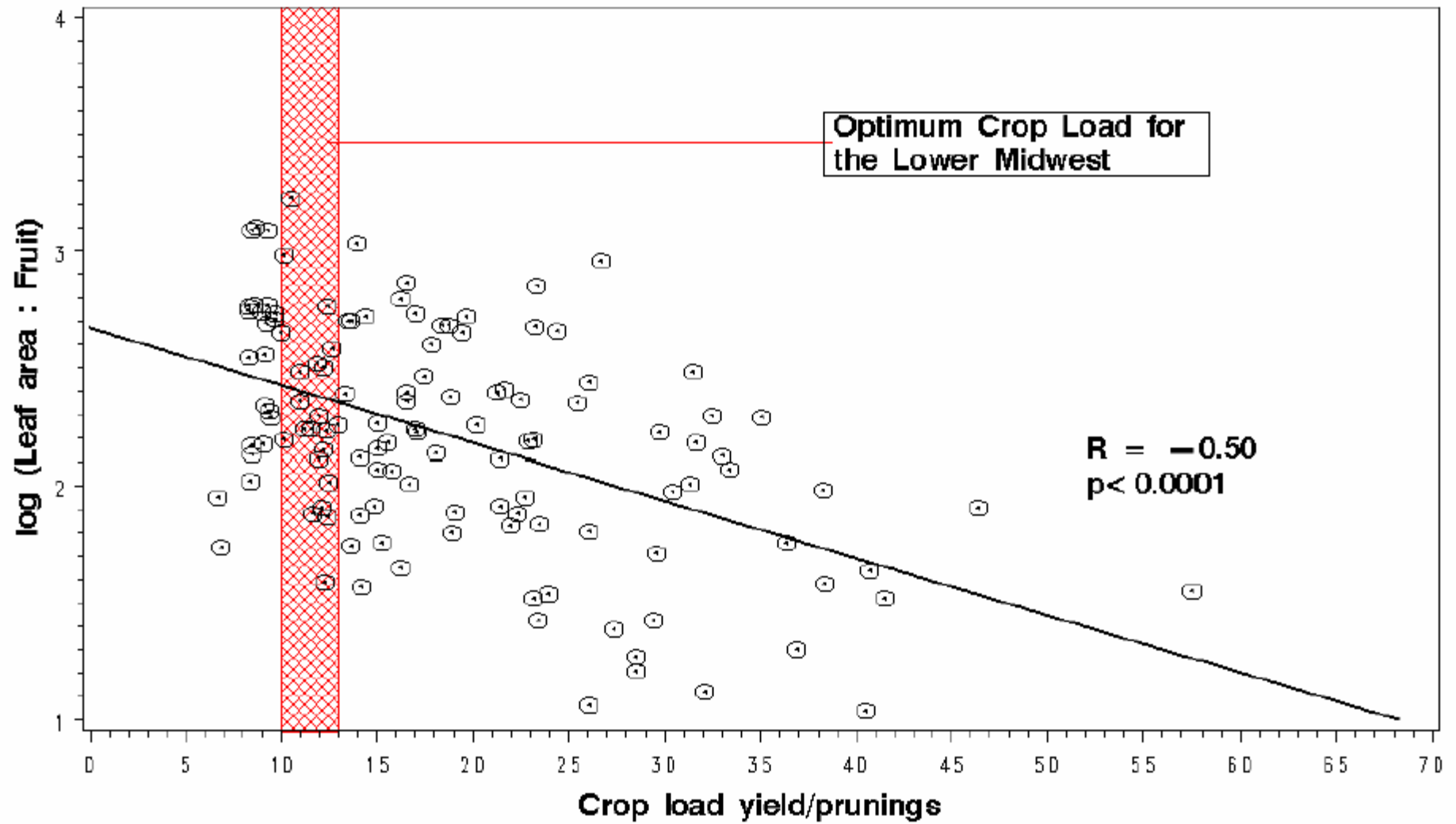
# Background of Balanced Pruning

- 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



# 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?

$$15 + 10$$


- The number of buds to retain for the 1<sup>st</sup> pound one-year old of prunings collected

- 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)

<u>Wt of prunings (lb)</u>	<u>No. of nodes retained</u>
1 (20 + 10)	20
2 (20 + 10)	30
3 (20 + 10 + 10)	40
4 (20 + 10 + 10 + 10)	50

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# 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

Healthy  
Primary  
bud

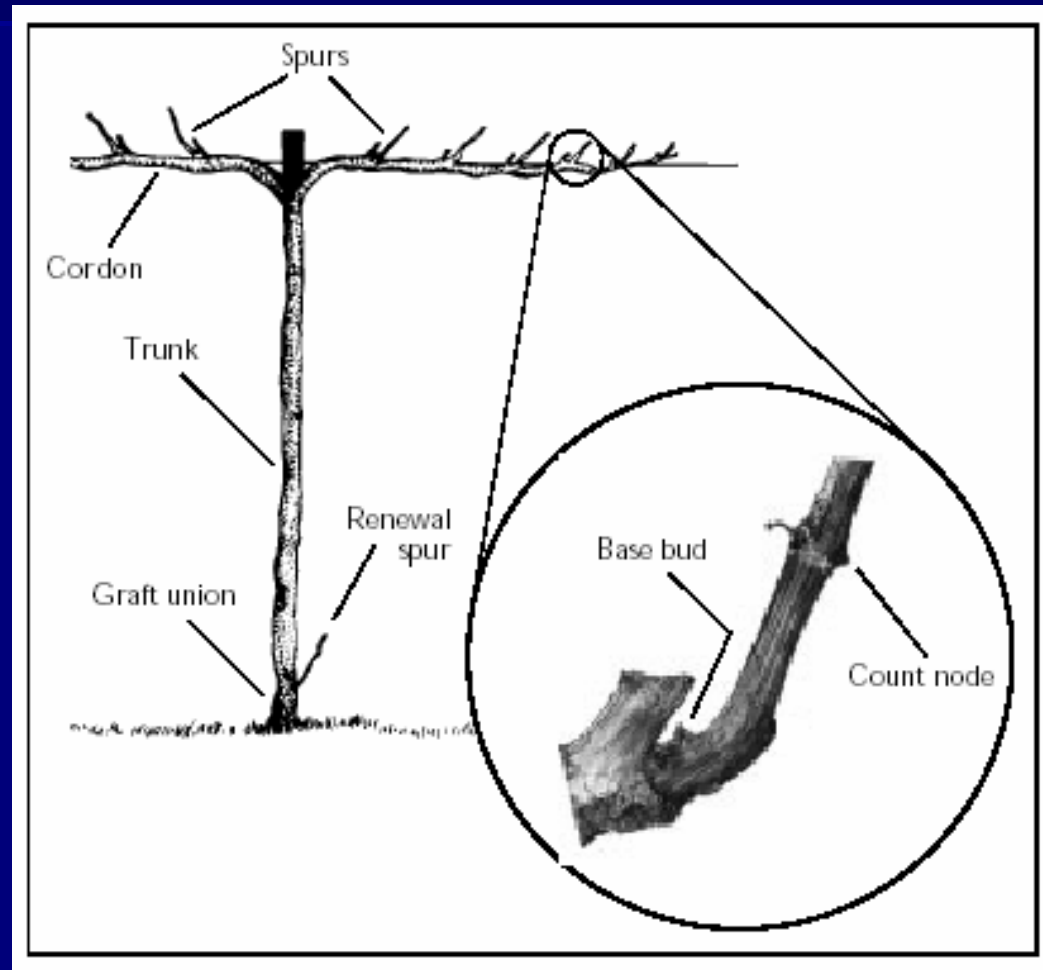


Injured Primary bud

- 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

### *Cultivar*

	<u>Nodes 1<sup>st</sup> lb</u>	<u>Nodes 2<sup>nd</sup> lb</u>	<u>Cropload</u>
<u><i>Small clustered cvs.</i></u>			
M. Foch	20	20	5-10(8-14)
L. Millot	20	20	5-10(8-14)
Vignoles	20	10	8-12
Norton	30	10	8-14
Cab. Franc	20	10	5-10



# Pruning formulae and Cropload Windows for various cultivars grown in Lower Midwest

## Cultivar

Nodes 1<sup>st</sup> lb

Nodes 2<sup>nd</sup> lb

Cropload

*Medium clustered cvs.*

Vidal	10 (20*)	10	10 – 13
Traminette	20	20	10 – 13
Chardonel	20	20	12 – 15
NY 70	20	20	12 – 15
NY 73	20	20	12 – 18

\* On rootstock

# Pruning formulae and Cropload Windows for various cultivars grown in Lower Midwest

Cultivar	<u>Nodes 1<sup>st</sup> lb</u>	<u>Nodes 2<sup>nd</sup> lb</u>	<u>Cropload</u>
<i>Large clustered cvs.</i>			
Chambourcin	20	20	10 – 13
Chancellor	20	20	12 – 18
Seyval	10(20*)	10	12 – 15
Villard blanc	20	20	12 – 18
NY 76	20	20	12 – 18

(\* On rootstock)

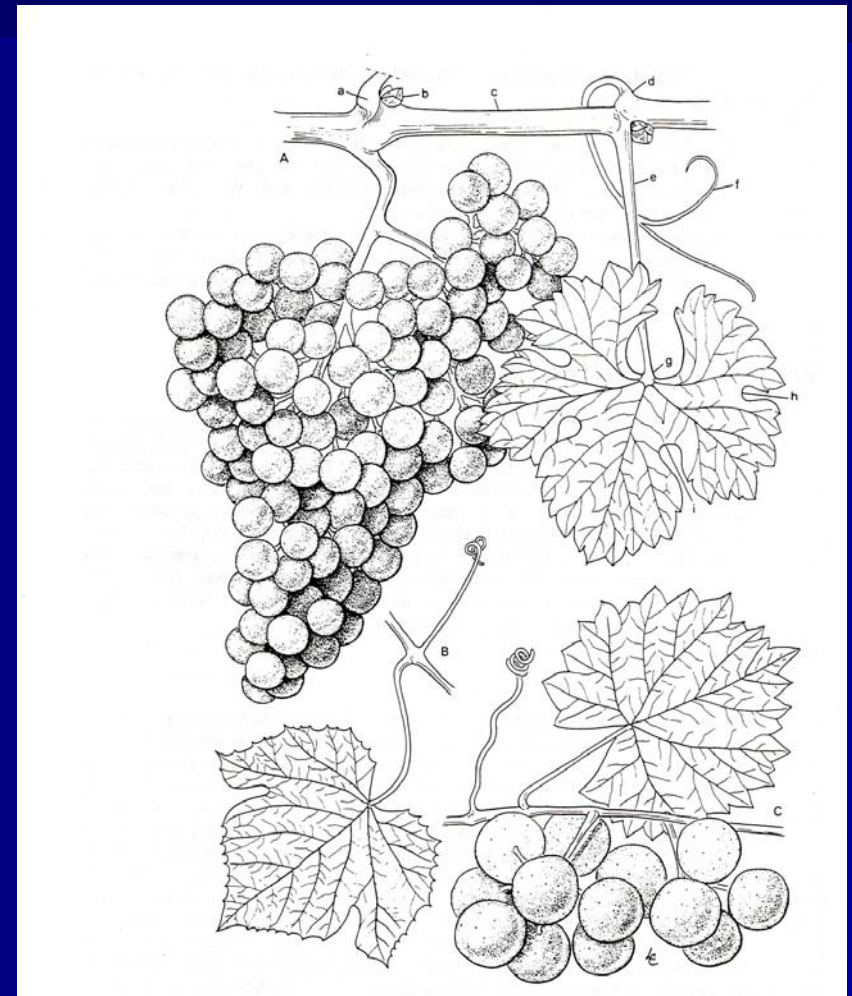
# CAUTION

- 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

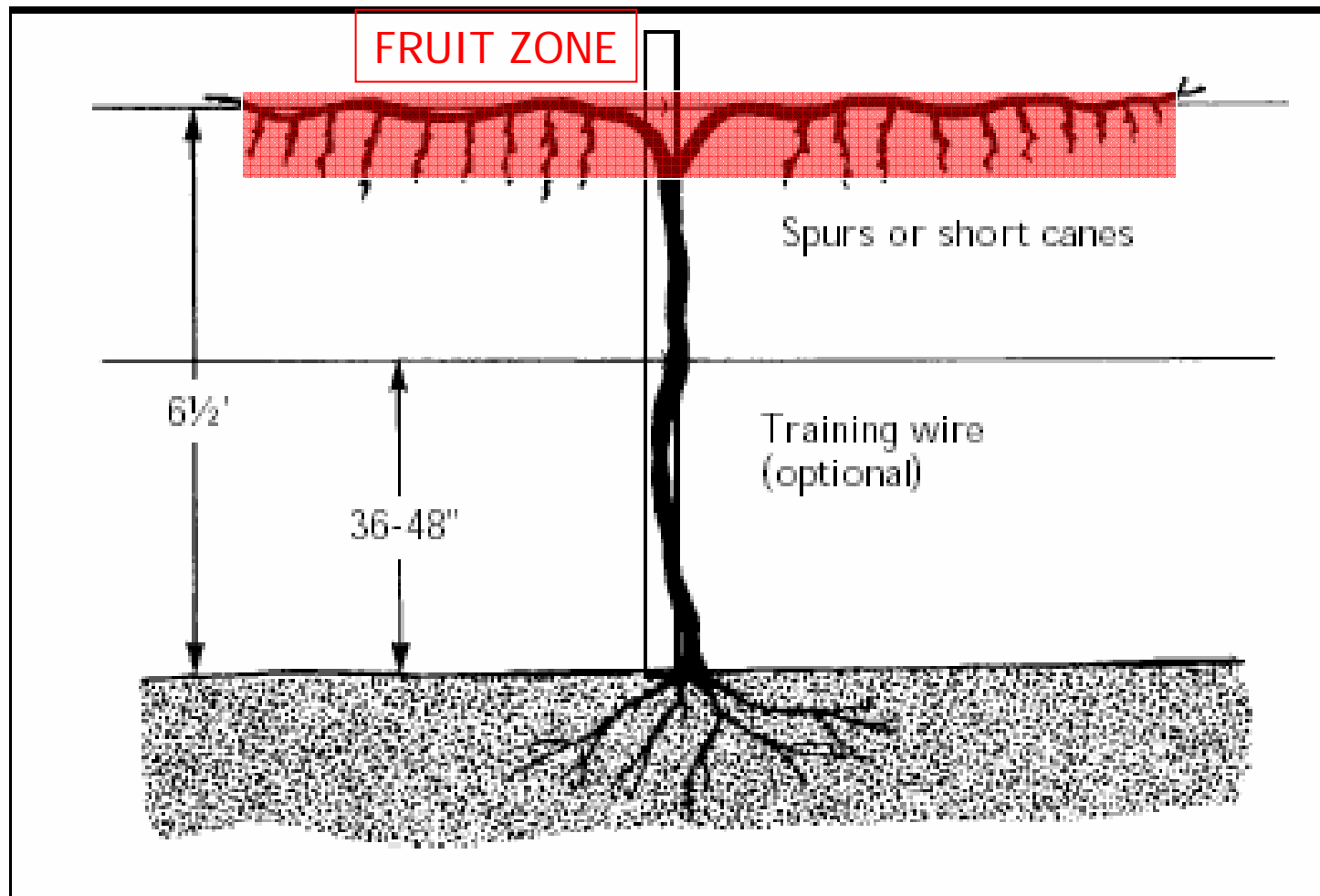
# Single curtain Bi-lateral High - Cordon

- 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



# Single curtain Bi-lateral High-Cordon

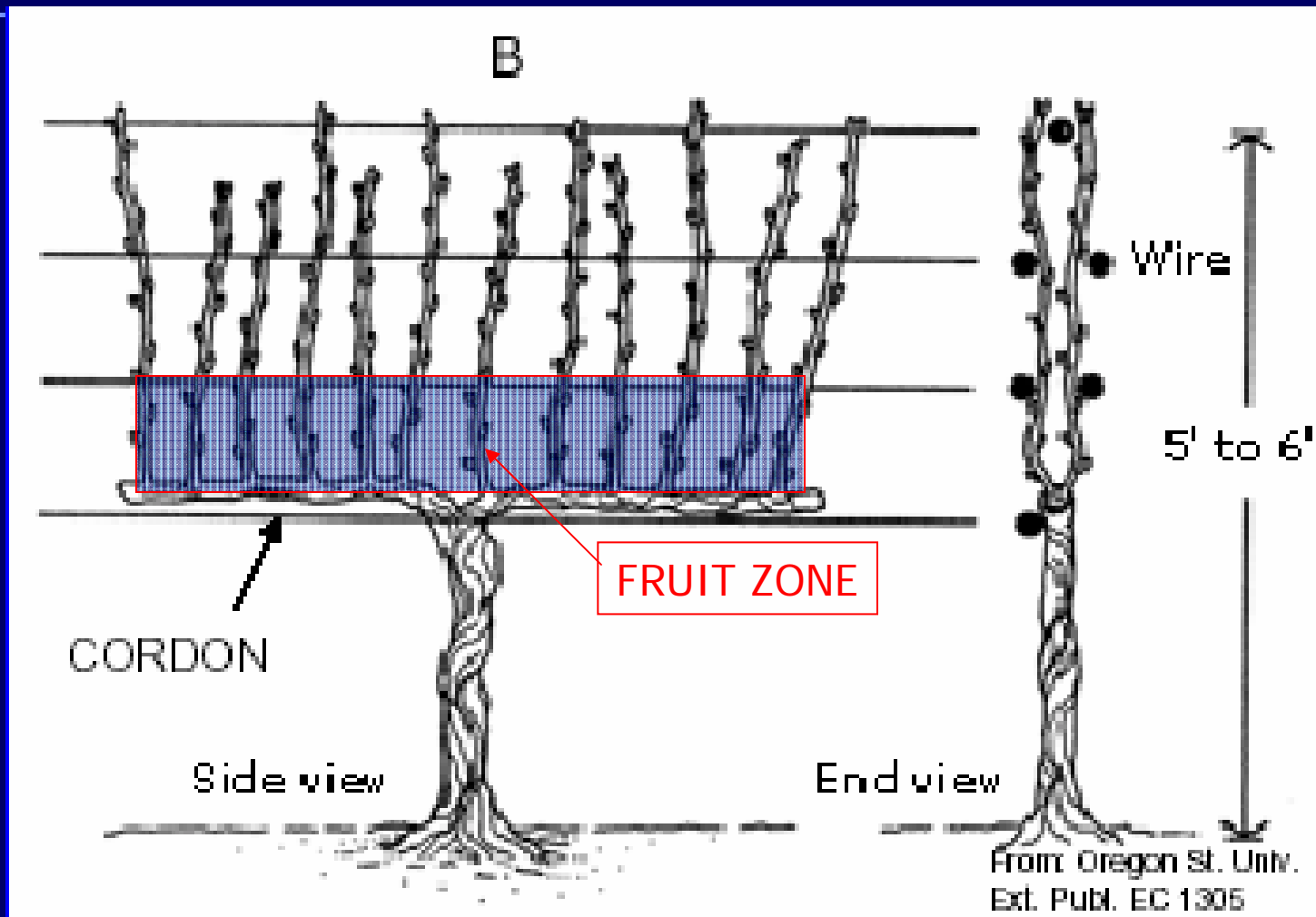


# Single curtain Bi-lateral Low-Cordon (VSP)

- 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)



# VSP



# Geneva Double Curtain

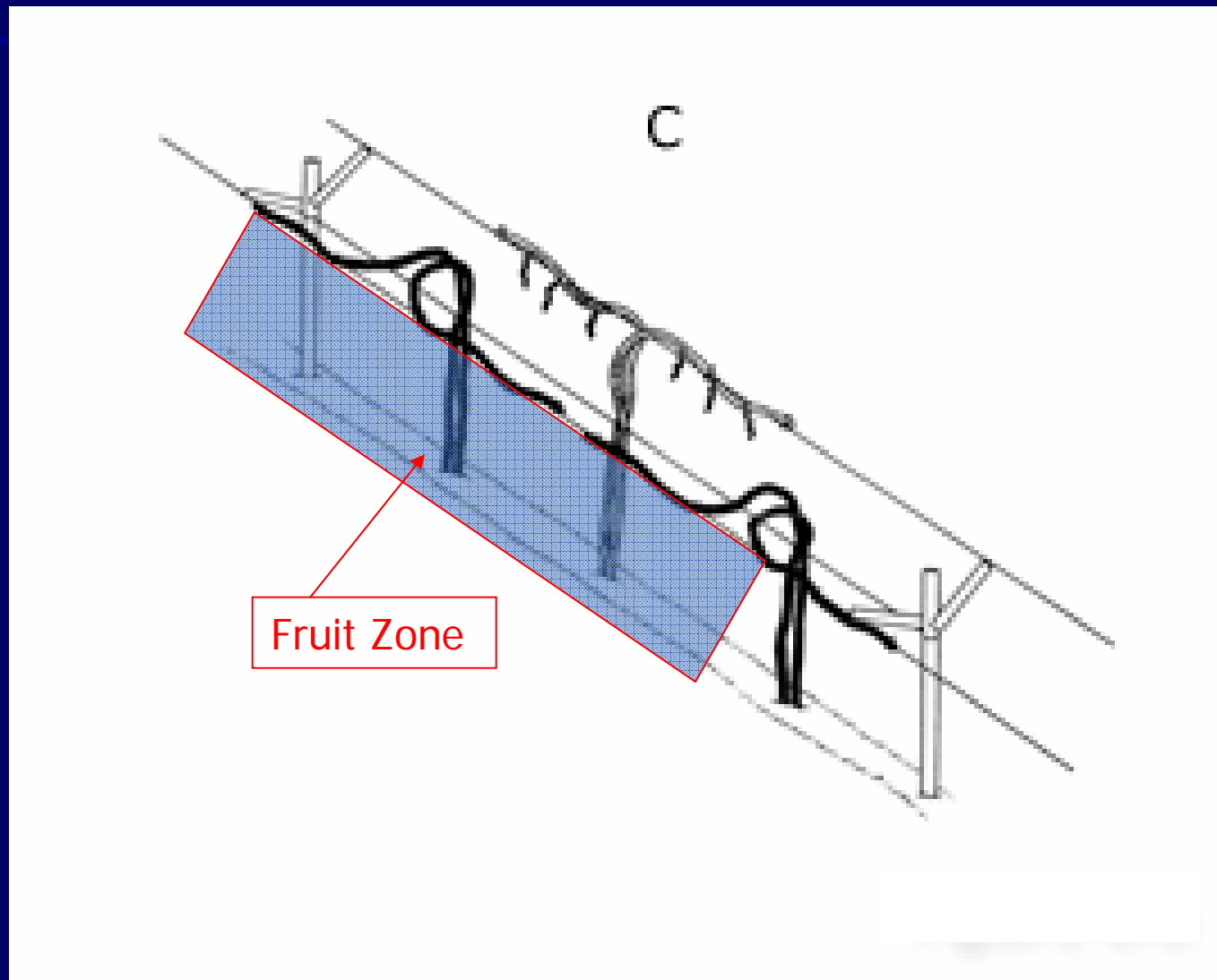
- Preferred for vigorous and shy-bearing cultivars ('Concord, Norton, Traminette, Sultana, Perlette)
- Spur or cane pruning (cultivars dependent)
- Advantages
  - Increased yield (20% - 90%)
  - Increased fruit composition
- Disadvantages
  - Cost of trellis
  - In warm regions reduced fruit quality especially in white varieties
  - Row spacing of at least 12' !!!!



# Geneva Double Curtain



# Geneva Double Curtain





# 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





Width

Length

Height



# 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)
  - (wet summers 1998, 2000, 2003)
- 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



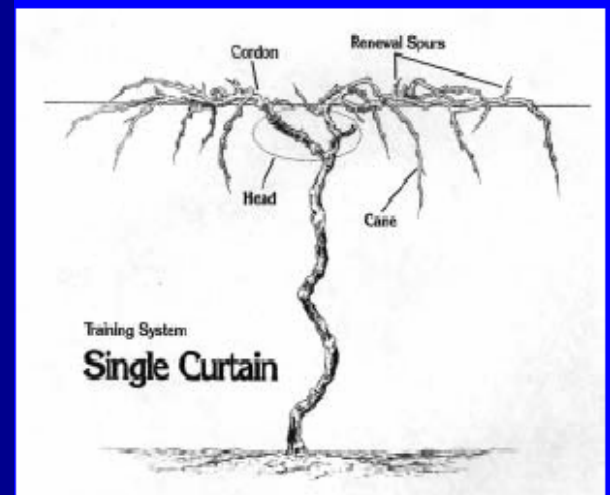
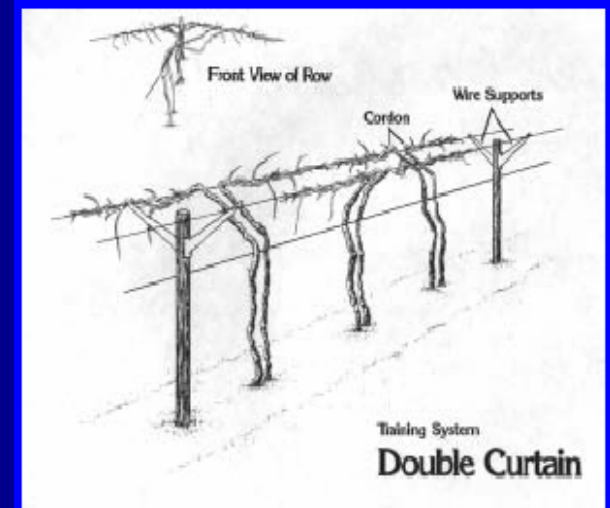
## 2) Shoot positioning

- Combing: Positioning shoots downward (High systems)
- Tucking: Positioning shoots upward (Low systems)



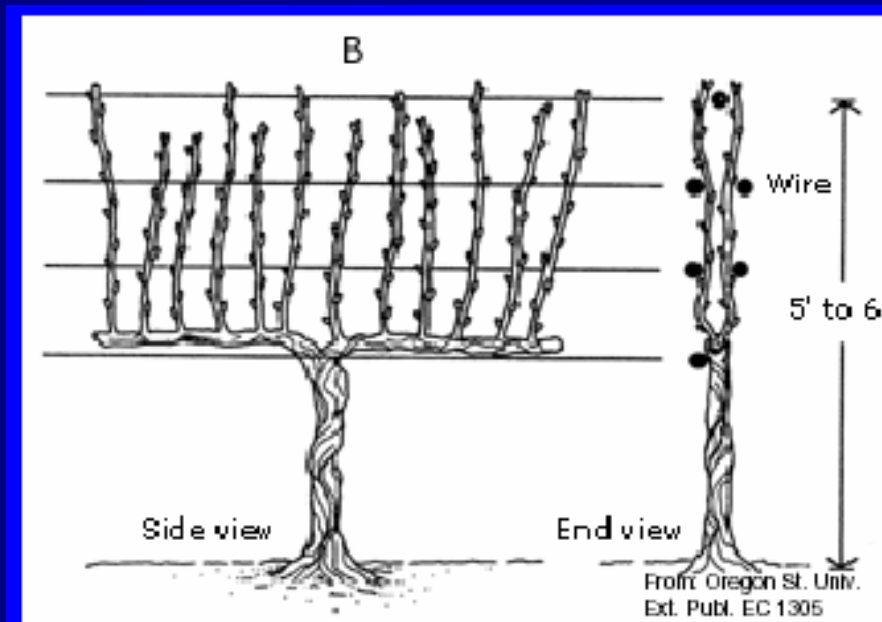
# Shoot positioning on High Trellis systems

## ■ 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