



# GROWING GRAPES IN VERMONT

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# Grape Origins

- *Vitis vinifera*: Middle East into Mediterranean Europe
  - Evidence of winemaking traced to at least 6000 B.C.
  - Domestication occurred ~3200 B.C.
  - Shiraz known by 800's AD
- Romans spread winemaking across Europe
  - By 100 AD, Rhine valley (Germany) had extensive plantations
- Spanish initially brought wines and vines to America during exploration and settlement
  - East coast vines died
  - West (California, NM) flourished

# Modern Advances in Viticulture

- Late 1800's, *Phylloxera* spread to France & other parts of Europe
  - Rootstocks from North American vines were (are) used to confer resistance
  - 'French American' hybrids developed to breed resistance
- Fungal diseases from New World (Downy Mildew)
  - Bordeaux mixture, 1880's
- Commodification of grapes and wine
  - Research on trellis design, cultivars, clones
- 2000: Spread to non-traditional sites
  - North: Idaho, Iowa, VT
  - South: Florida, TX

# Grapes in Vermont (and other crazy cold places)

- Vermont: 22 bonded (grape) wineries; ~ 200 acres grapes?
- Minnesota: 30 wineries, 700 acre (2009)
- Iowa: 85 wineries, 1200 acres (2010)
- Kentucky: 50 wineries, 500 acres
- Idaho: 40+ wineries, 1500 acres

# Why is there a developing winegrape industry in Vermont now?

- GLOBAL WARMING??
- Breeding of cold-hardy, high quality wine grapes in recent years

**'La Crosse'**



**'Prairie Star'**



**'Frontenac'**



**'Marquette'**



# Grape growing limitations

- COLD!!
- Majority of grapes (table, wine) are vinifera
  - -15°F at best
- Native grape industry includes Concord (#1), Delaware, Himrod, Catawba
  - -20 to -30°F BUT
  - Require long growing season and...
  - Commodity markets in major growing areas depress prices for marginal sites

# Is your site suitable for grapes?

<b>Climate</b>	<b>Topography</b>	<b>Soils</b>
<ul style="list-style-type: none"><li>• <b>Winter Temperatures *</b></li><li>• Spring Frosts</li><li>• Length of Growing Season</li><li>• Growing Degree Days</li><li>• Precipitation</li></ul>	<ul style="list-style-type: none"><li>• <b>Relative Elevation*</b></li><li>• <b>Nearness to a large body of water*</b></li><li>• Degree of Slope</li><li>• Direction of Slope</li></ul>	<ul style="list-style-type: none"><li>• <b>Drainage</b></li><li>• Moisture Holding Capacity</li><li>• pH</li><li>• Fertility</li><li>• Organic Matter</li></ul>

\* The most important consideration

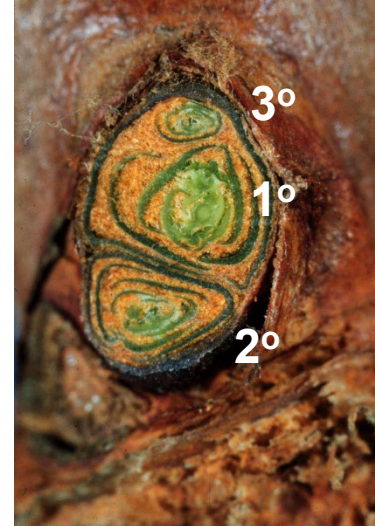
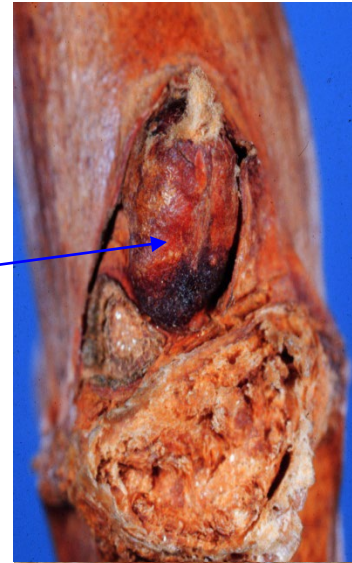


# Winter Temperatures

Determine what cultivars can be grown & how productive they will be.

**Cane buds** are the most tender portion of a grape vine.

- **A compound bud with the potential to produce 3 or more shoots.**
  - **1° bud: The most productive.**
  - **2° bud: Less productive; varies with type & cultivar.**
    - American types 50% or less productive
    - French hybrids 60-80% as productive.
  - **3° bud: Very un-productive**





# Challenges with Growing Grapes in Vermont

- Bud injury occurs between -10 and -25 degrees F.
- Select cultivars which mature within your growing season (frost free period).
- Success depends upon selected cultural management practices
- KEY-
  - Protect vines from cold at the most critical stages
    - Variety selection (genetic hardiness)
    - Site selection (meso/micro climate)
    - Winter protection (training/protection)
    - Vegetative management (healthy tissue, retard bud break)

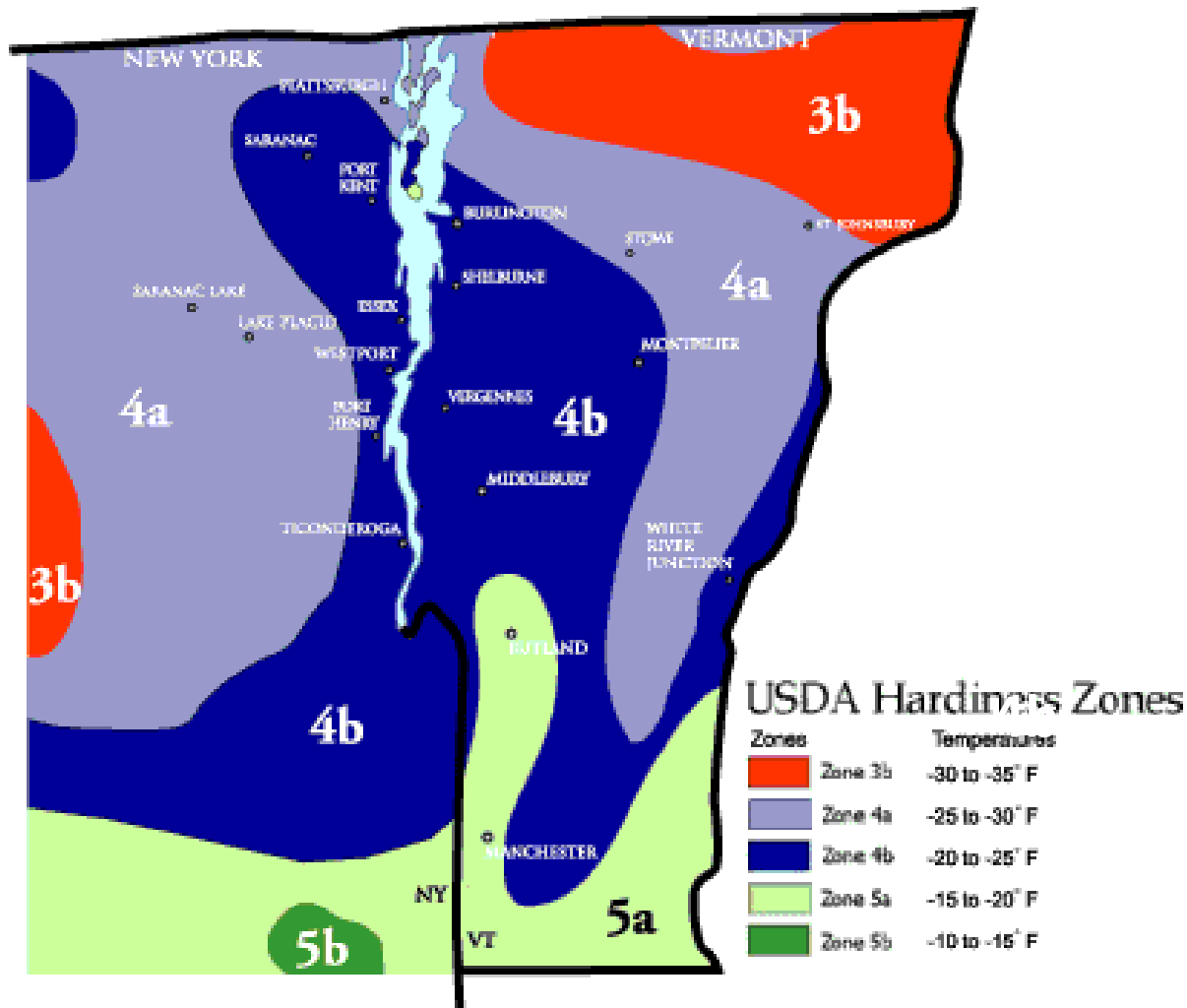
# Classification of Vine Hardiness

Based on the temperature at which injury begins to occur

Temp. (F°)	Category	Suitable Type
$\geq 0$	Very cold tender	Almost any.
- 5	Cold tender	Most northern <i>vinifera</i> .
- 10	Moderately Hardy	Hardy <i>vinifera</i> , moderately hardy French hybrids.
- 15	Hardy	Hardy French hybrids, most <i>labrusca</i> .
$\leq - 20$	Very hardy	Hardy <i>labrusca</i> , most <i>riparia</i> hybrids.

# USDA Hardiness Zone Map

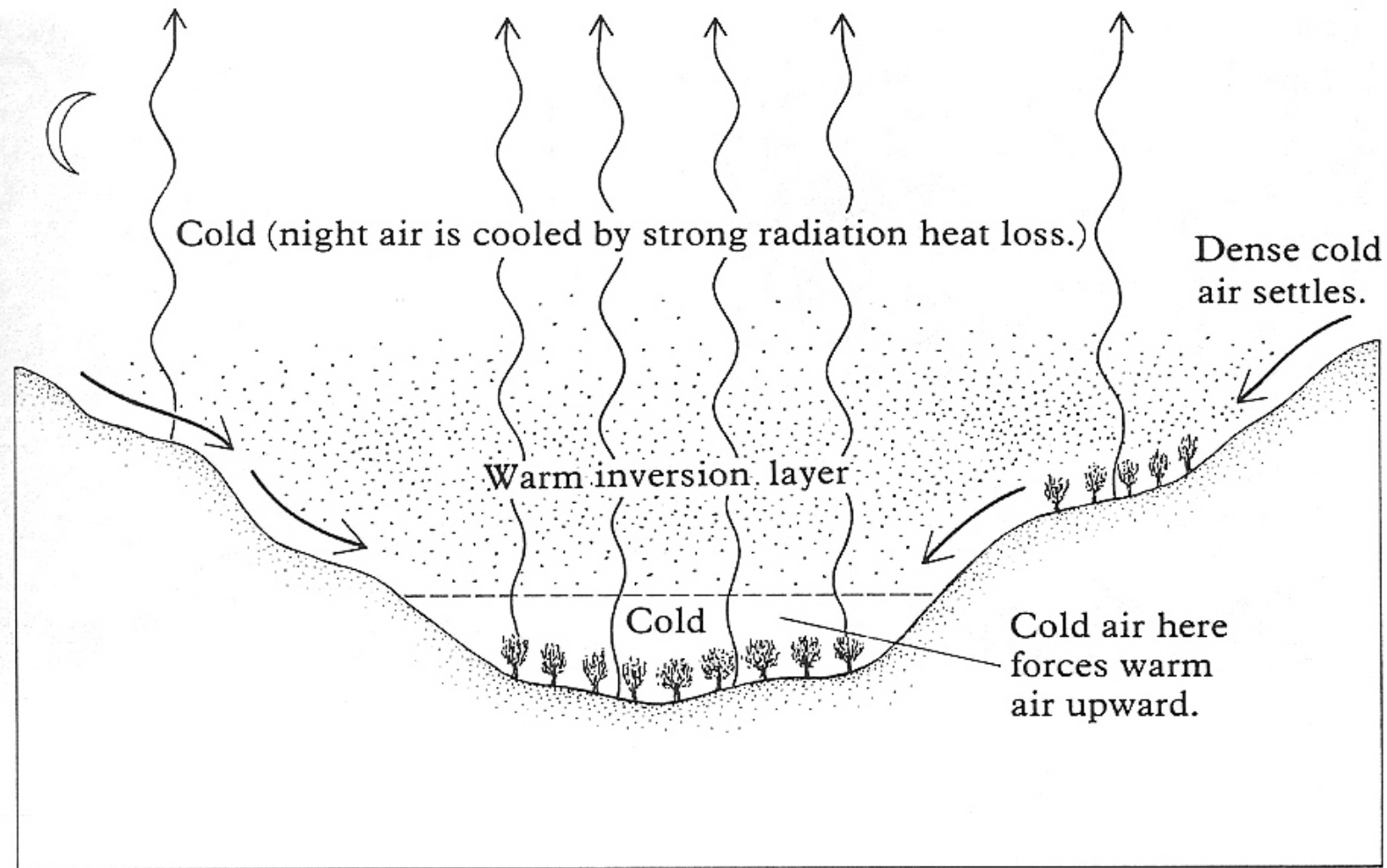
PLANT HARDINESS ZONES IN VERMONT AND NEW YORK



# Length of the Growing Season

<b>Frost-Free Days</b>	<b>Suitability for Grapes</b>
<b>&lt; 150</b>	<b>Unacceptable ?</b>
<b>150 to 160</b>	<b>Marginal:</b> Only early season maturing varieties.
<b>160 to 170</b>	<b>Satisfactory:</b> Early & most mid-season maturing varieties.
<b>170 to 180</b>	<b>Good:</b> Early, mid-season & some late-season varieties.
<b>&gt; 180</b>	<b>Excellent:</b> Most varieties.

Is often very site specific.



**Figure 15-17** A schematic view of a valley with trees planted on the floor and up a slope. On clear, still nights, strong radiation heat loss at the earth's surface cools the air. The dense cold air that is formed settles at the bottom of the valley, forcing warmer air up to a higher level—thus producing a temperature inversion, which is advantageous to the trees on the slope on frosty nights.

# Lake effects



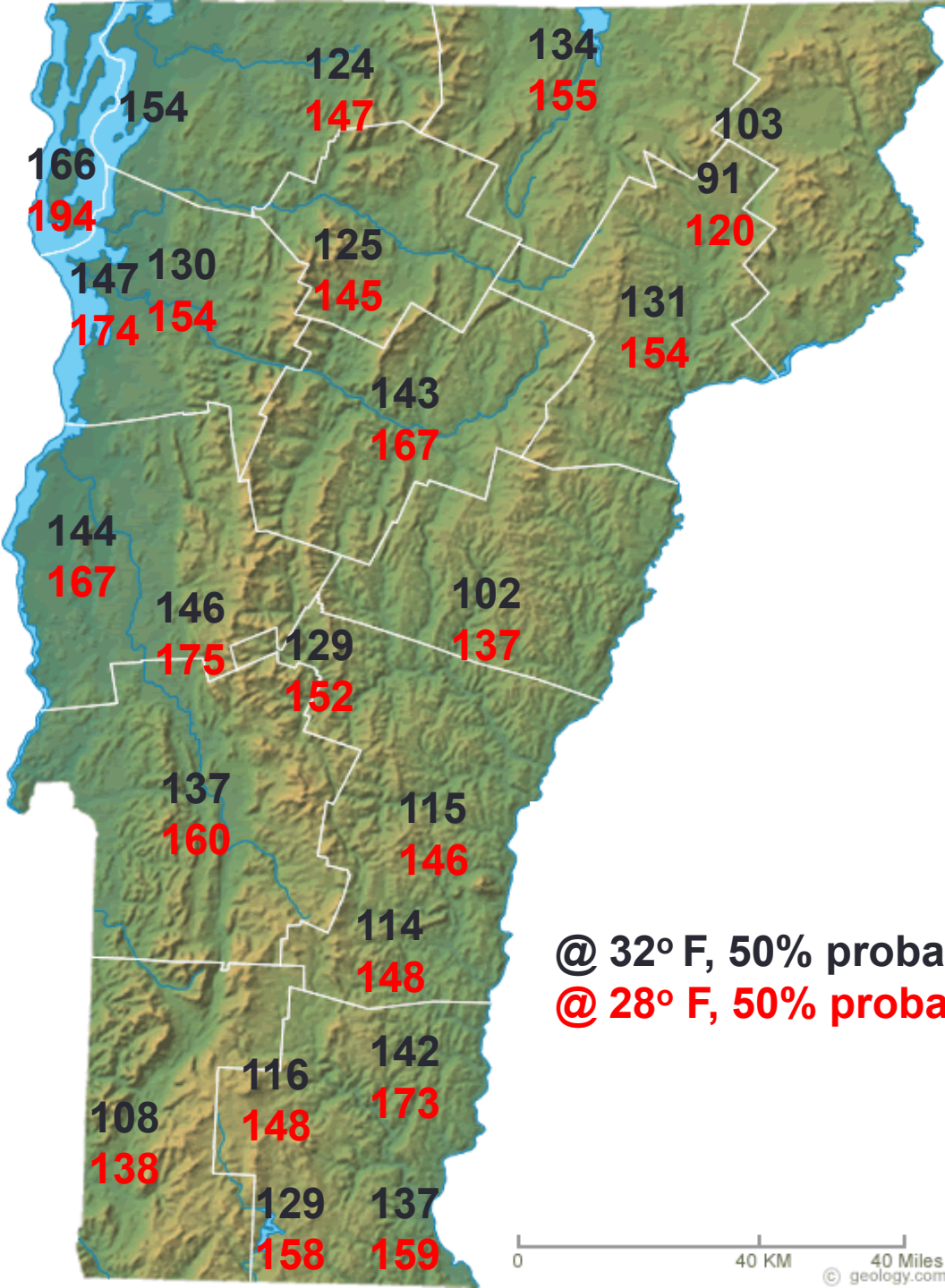


# Lake effects





# Frost Free Days



@ 32° F, 50% probability  
@ 28° F, 50% probability

# Soil Selection Factors

- Internal Drainage
- Moisture Holding Capacity

Texture

Depth

- pH
- Fertility



# What Can be Done to Improve Soil Drainage

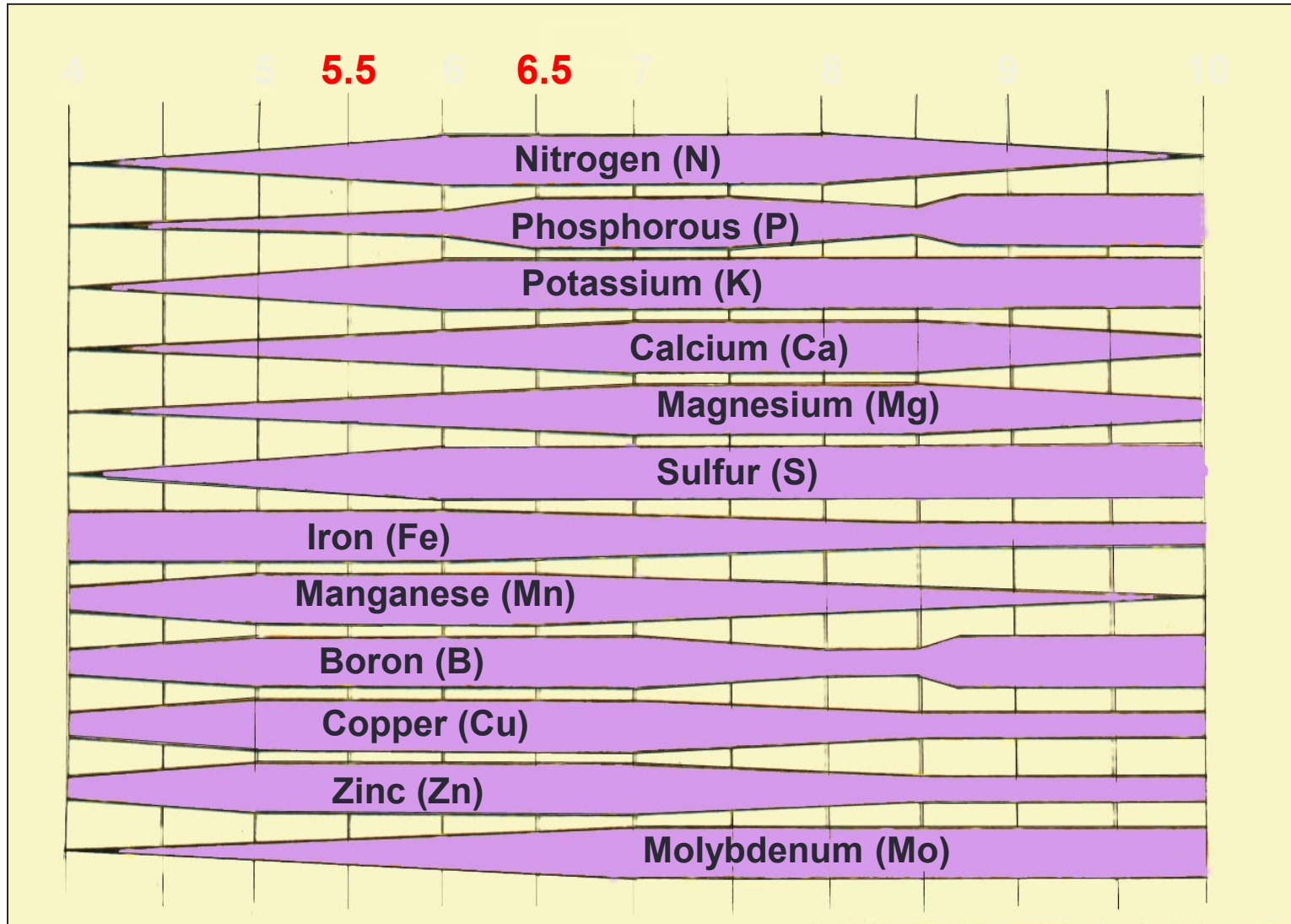
- **Sub-soil before planting**
  - Effective for compacted soils if there is good soil below.
- **Plant on raised beds**
  - Suitable on moderately well drained soils.
  - Maybe okay for somewhat poorly drained soils.
- **Install drainage tile**
  - Suitable for somewhat poorly drained soils.
  - Maybe okay of poorly drained soils (distance between tile lines & cost become a factor).

# Soil pH for Grapes

- **Desired range: 5.5 to 6.5**
  - American: 5.0 to 6.5 (~ 6.0 optimum)
  - French Hybrid: 5.5 to 6.5; (6.0 to 6.5 optimum)
    - **Will tolerate a pH up to ~ 7.0**
- **Adjust Soil pH:**
  - Below 6.0: bring up to 6.0 or 6.5 with lime.
  - Above 6.8 or 7.0: consider lowering to 6.5 or 6.0 with sulfur, or using acid forming fertilizers (ammonium sulfate).

# Soil pH

## Nutrient Availability as Influenced by Soil pH





# Soil Fertility

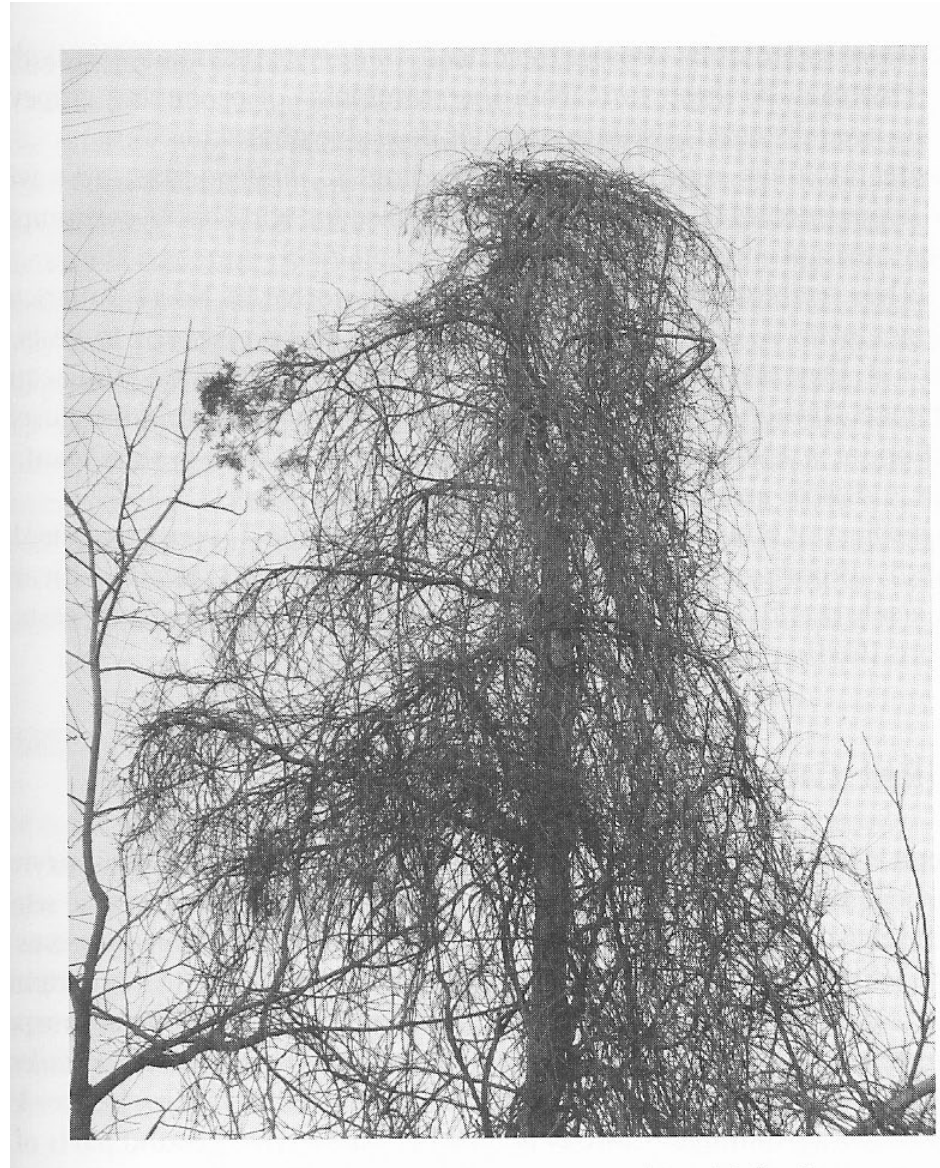
- **Least concern when selecting a site.**
  - Can amend the soil.
- **Concerns:**
  - **P** Immobile in the soil.
    - Pre-plant application is the only economical chance to correct a shortage.
    - Often high where manure has been applied.
  - **K** Grapes have a high requirement for K.
    - Can stratify where cultivation is not practiced as in a vineyard.
    - Excessive soil Mg can inhibit the uptake of K.
  - **Mg** Can be low in many eastern soils, particularly on sandier soils.
    - Uptake of Mg can be inhibited where K has been over-applied.
  - **Zn** Grapes have a relatively high requirement for Zn.

# Grape growth habit

- Grapes are a liana: a climbing vine
  - Generally require support
  - Ecological niche: canopy climbers
    - Strong apical dominance
    - 'Plastic' growth habit, malleable to grower's training systems
      - Allows Growers to manipulate the plant for commercial needs
        - Yield
        - Mechanization
        - Cold Hardiness
        - Ripening

# Grape Habit

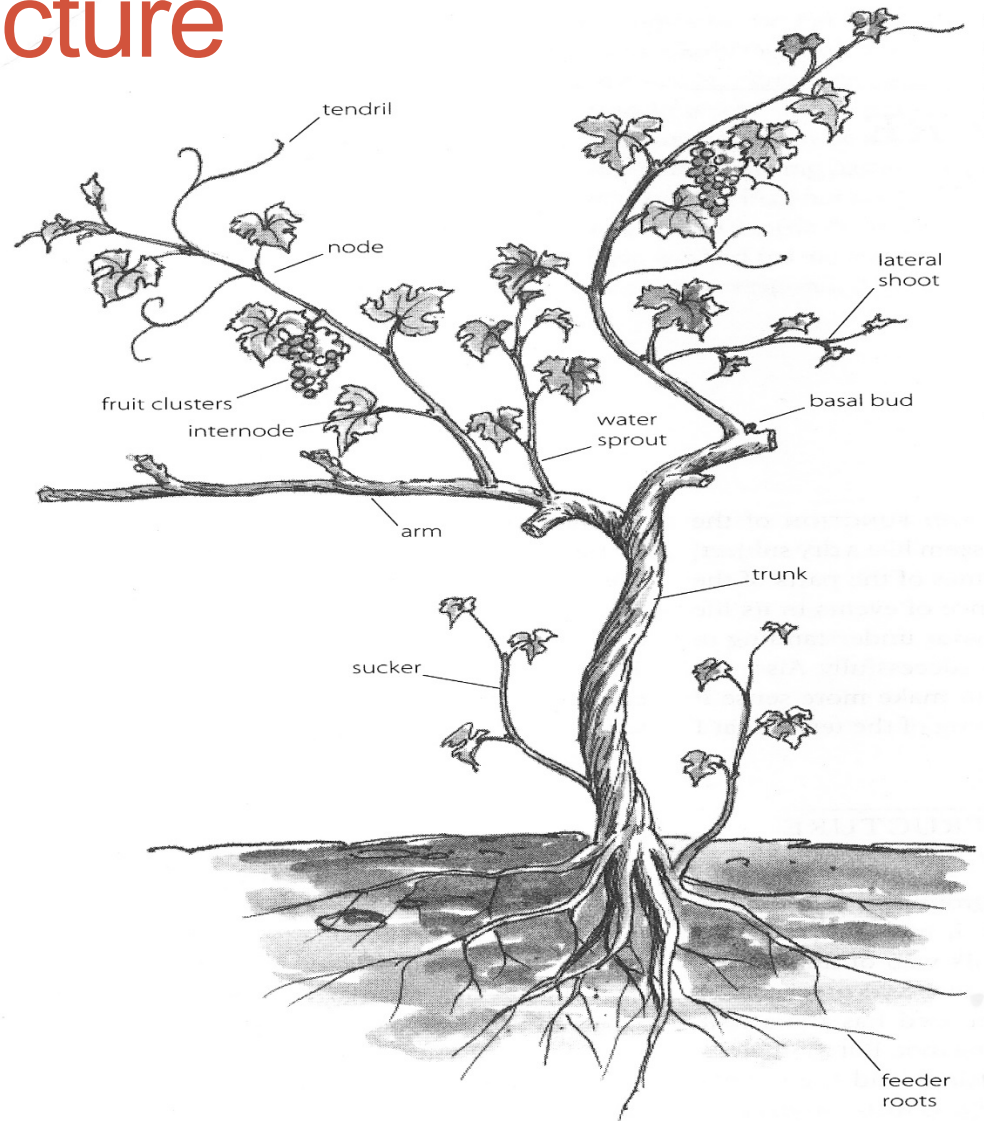
- Wild vine growth uses existing structures (trees) for support
- Apical dominance encourages growth vertically to exploit solar reception



Source: Creasy & Creasy,  
*Grapes*

# Grape Plant Structure

- Trunk
- Arm/Cordon
- Buds
- Suckers
- Lateral Shoots
- Tendrils



Structural components of a grape vine.





# Grape Flowers

- Wild grapes typically are dioecious
- Most grape *cultivated* varieties have hermaphroditic, self-fertile flowers





# Getting Started with your home vineyard

- Site Selection – full sun
- Sources of vines – propagation
  - Northeast Vine Supply
  - Double A Vineyards
- Spacing 6-8 ft x 10 ft
- Build the trellis before planting?
- Plan training system

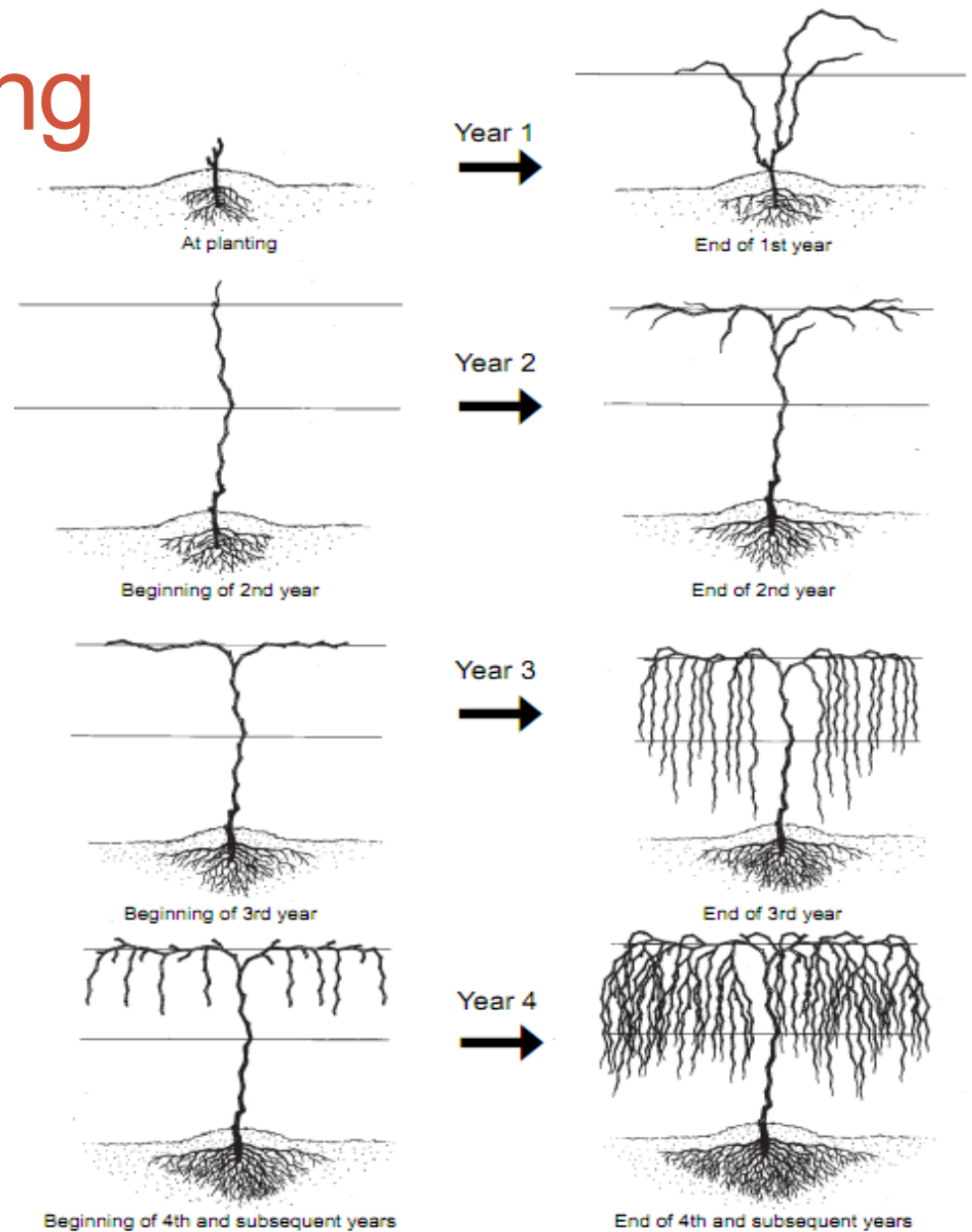
# Planning the vineyard

- Expect 10-20 pounds of grapes per mature vine
- Expect 1-2 gallons wine from those grapes *if hardy and well-managed*
- Vines require 50-100 sq feet of space
- SO:
  - A vinyard to support a 25 gallon annual home winery would require:
    - 25 vines
    - 6 x 10 ft spacing = 60 sq ft each
    - =1500 sq feet of vineyard

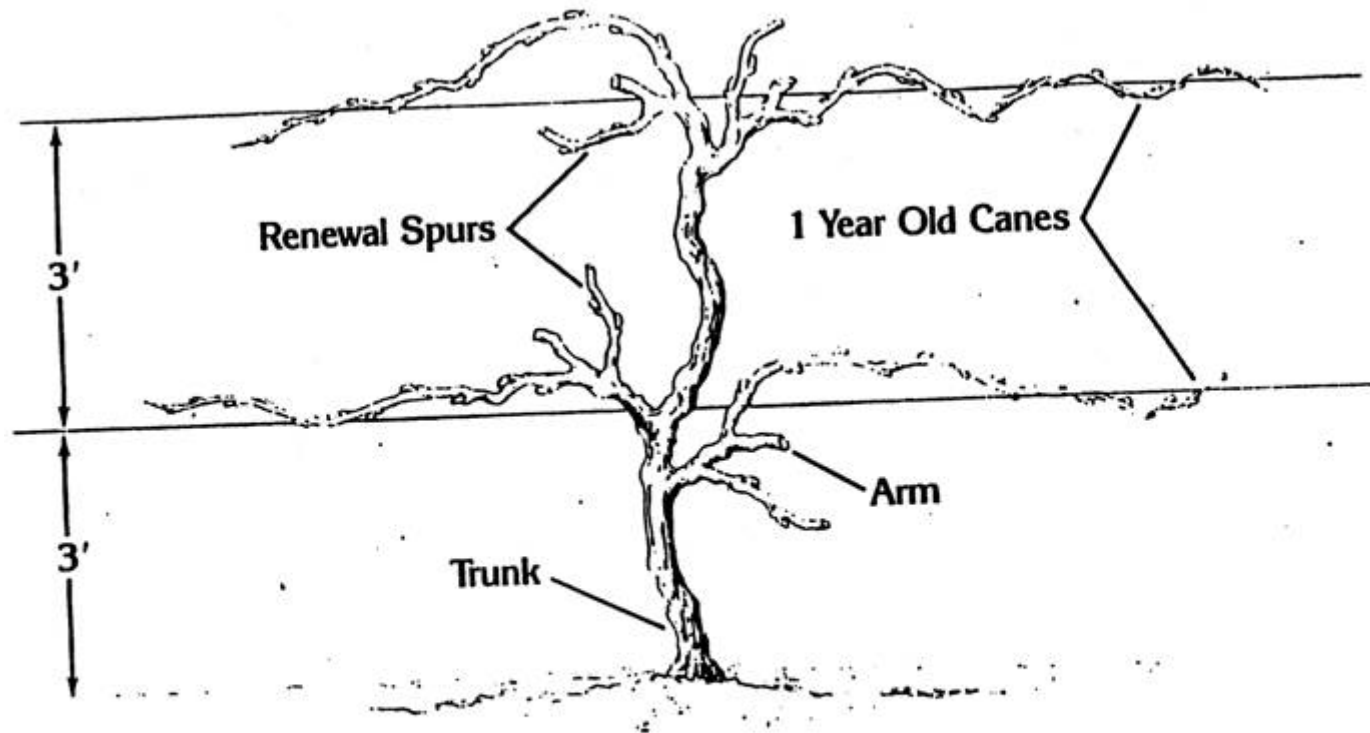
# Planting Vines

- Early spring is the best time to plant grapevines.
- Fall planting is not recommended because plants are likely to be lost to heaving and cold damage.
- During the first year, the vines are normally tied to a stake to keep them off the ground.
- **Season 1:** Tie all growth to a vertical stake and control weeds
- **Season 2:** Train a single trunk plus one renewal spur to the wire, remove all else
- **Season 3:** Develop fruiting arms (cordons) or vine head

# Early vine training



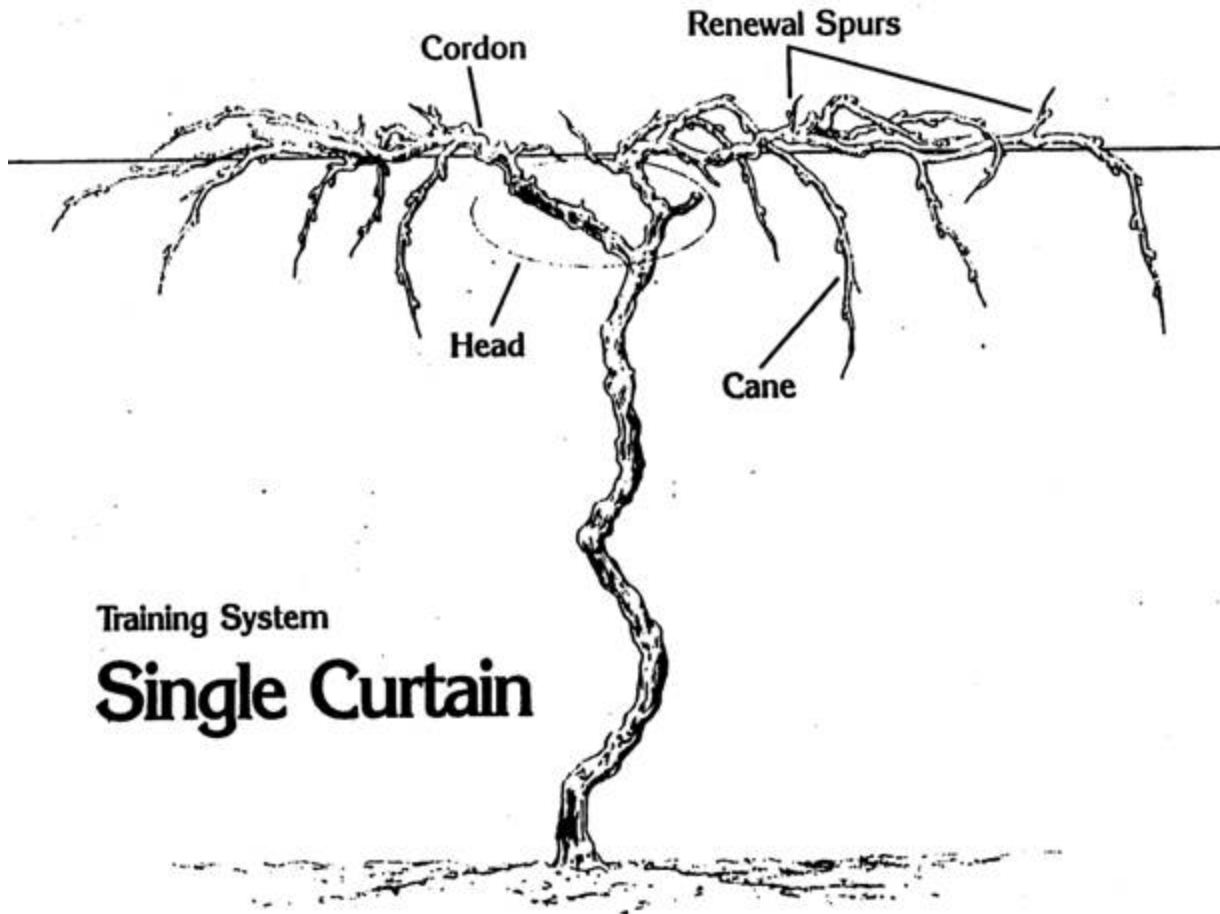
# Training System 4-Cane Kniffin



Training System

## 4-Cane Kniffin

# Training System Single Curtain



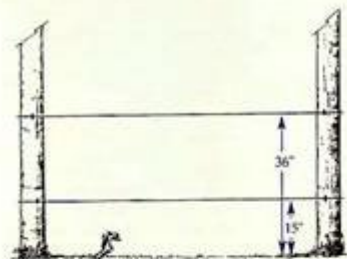


# Training System Single Curtain

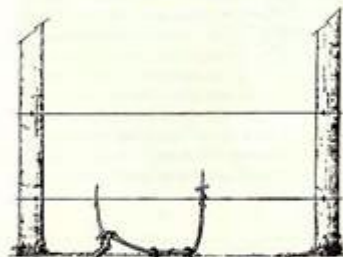


# Training System

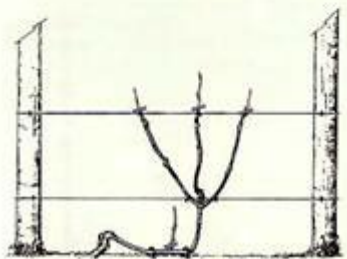
## Open Fan



At planting



First year

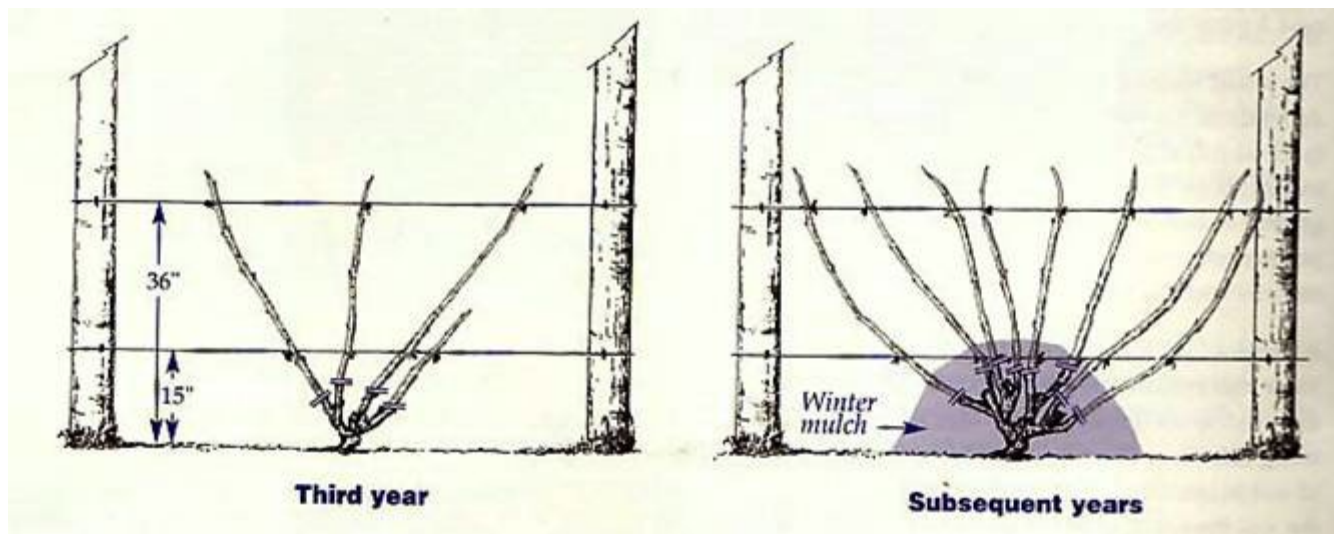


Second year





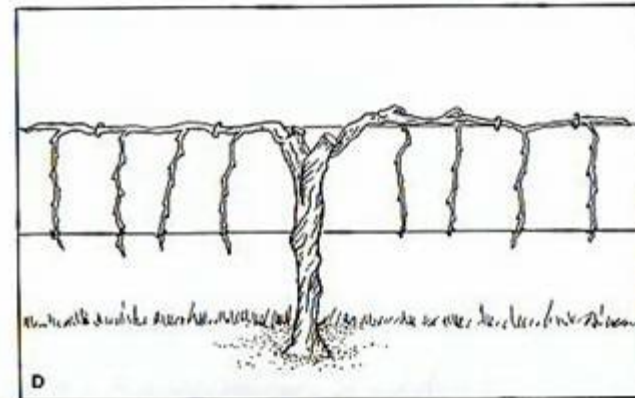
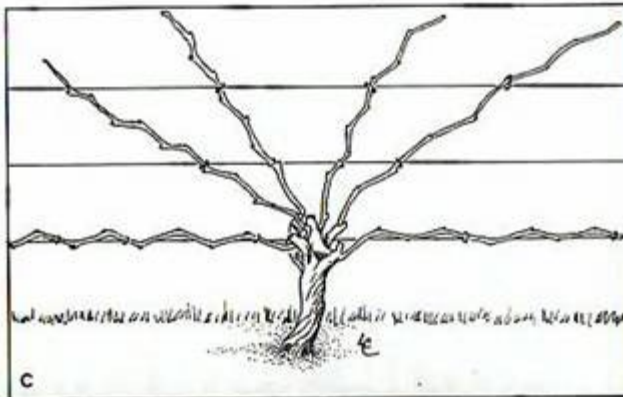
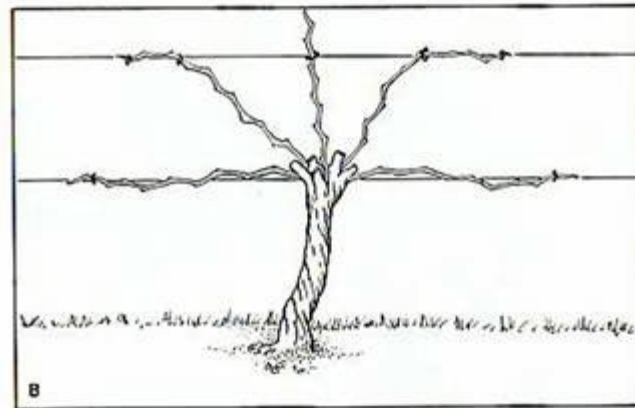
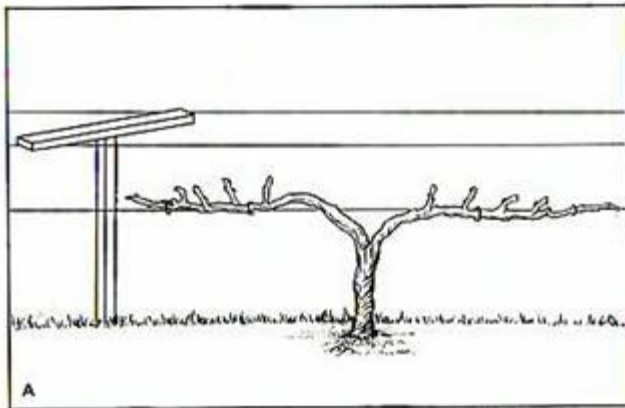
# Fan System (with mulch potential)



# Winter Mulch

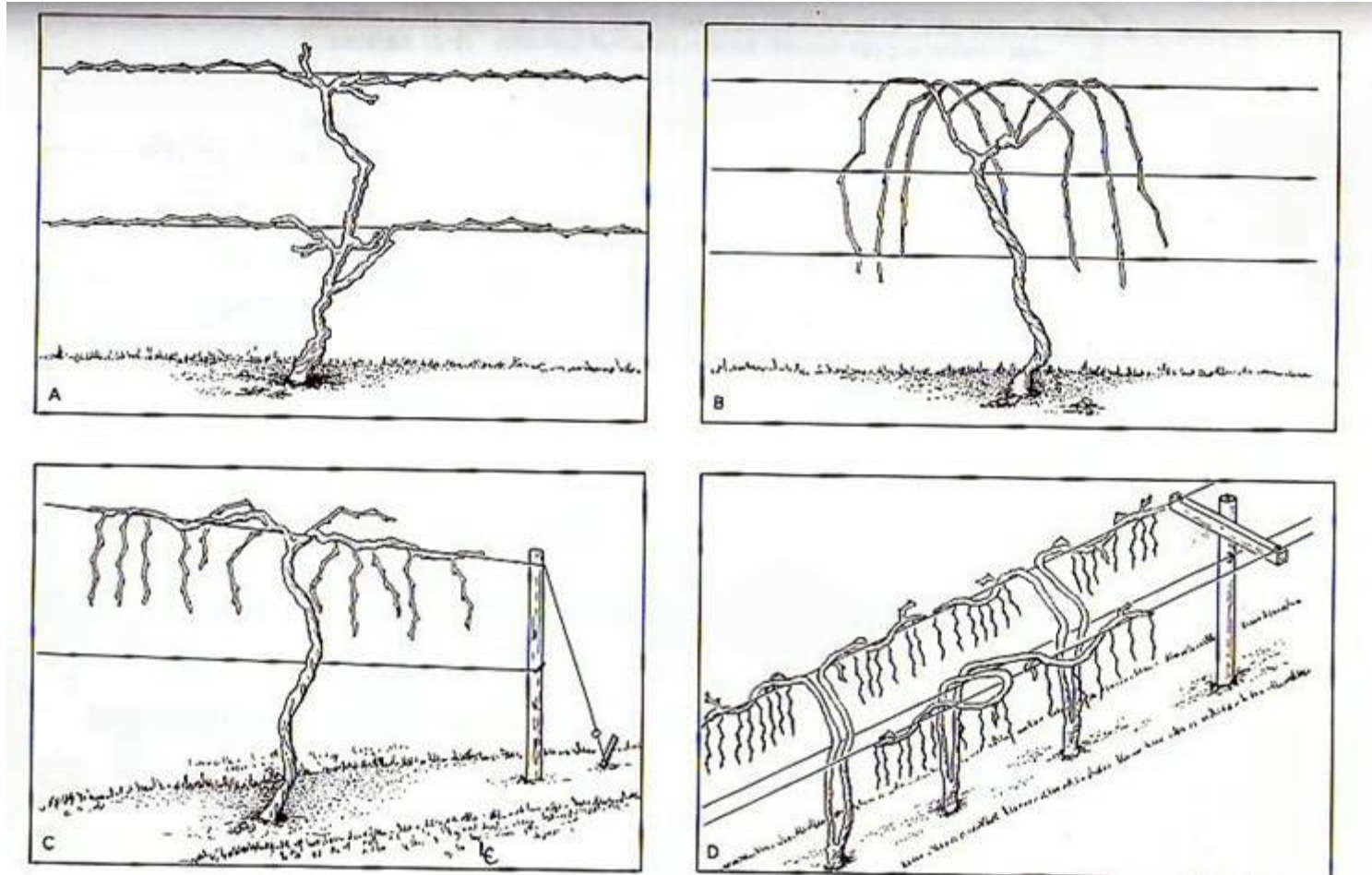
- Snow
- Bury in Soil
- Use organic mulch (hay, straw, etc...mice can be a problem.)
- Uncover and trellis before spring growth begins.

# Spur and Cane Training

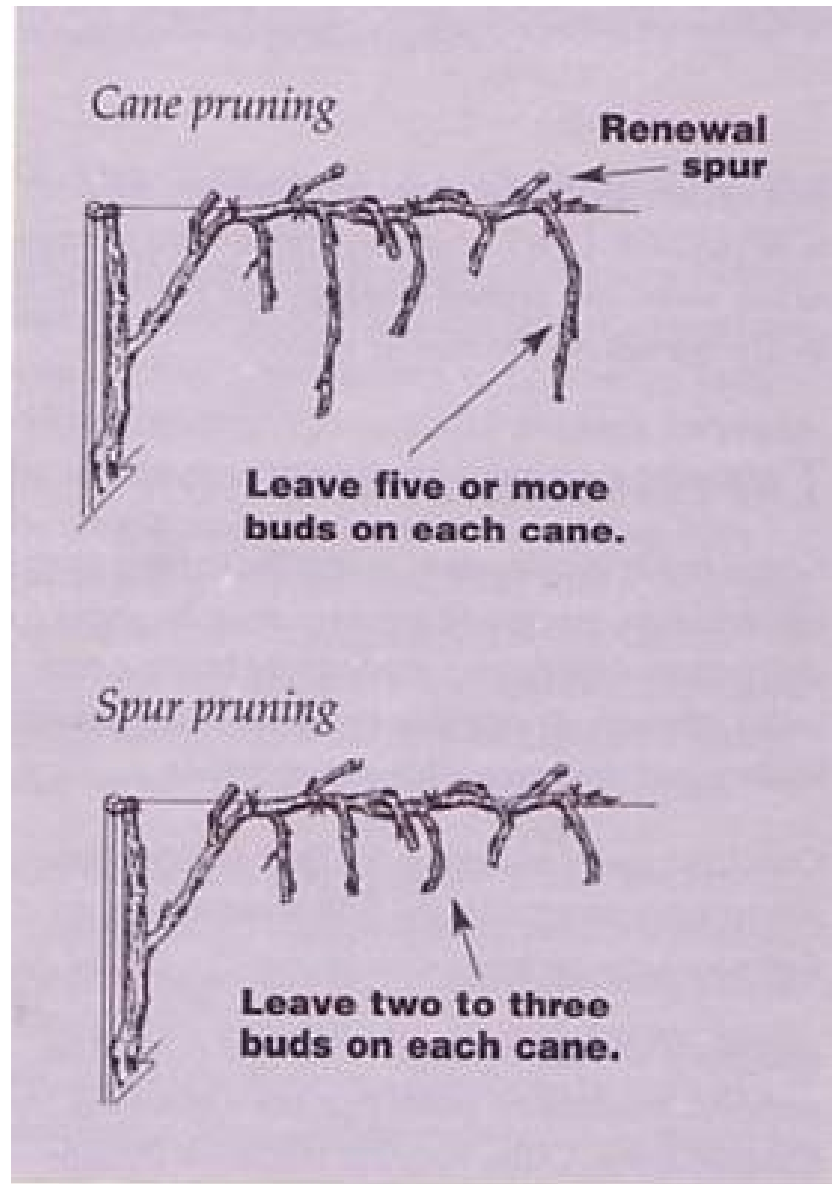




# Cane Pruning Systems



# Seasonal Pruning (About 40 buds per plant)



# Pruning

- Annual pruning is important in maintaining a uniform yearly production of quality fruit.
- The best time to prune grapevines is in the dormant season after the danger of severe cold weather has past.
- When 'Lay-down' management is used, prune mildly in fall and complete pruning at spring trellising.

# Pruning

- Mature vines:
  - Prune to a determined # of buds
  - Rule of thumb, 6 buds/foot of canopy
    - Remove some if no cold damage
  - Cold-damaged vines, leave more buds BUT
    - If too much fruit sets (>4 clusters/foot of canopy), remove fruit clusters just after set

# Pruning





# Pruning

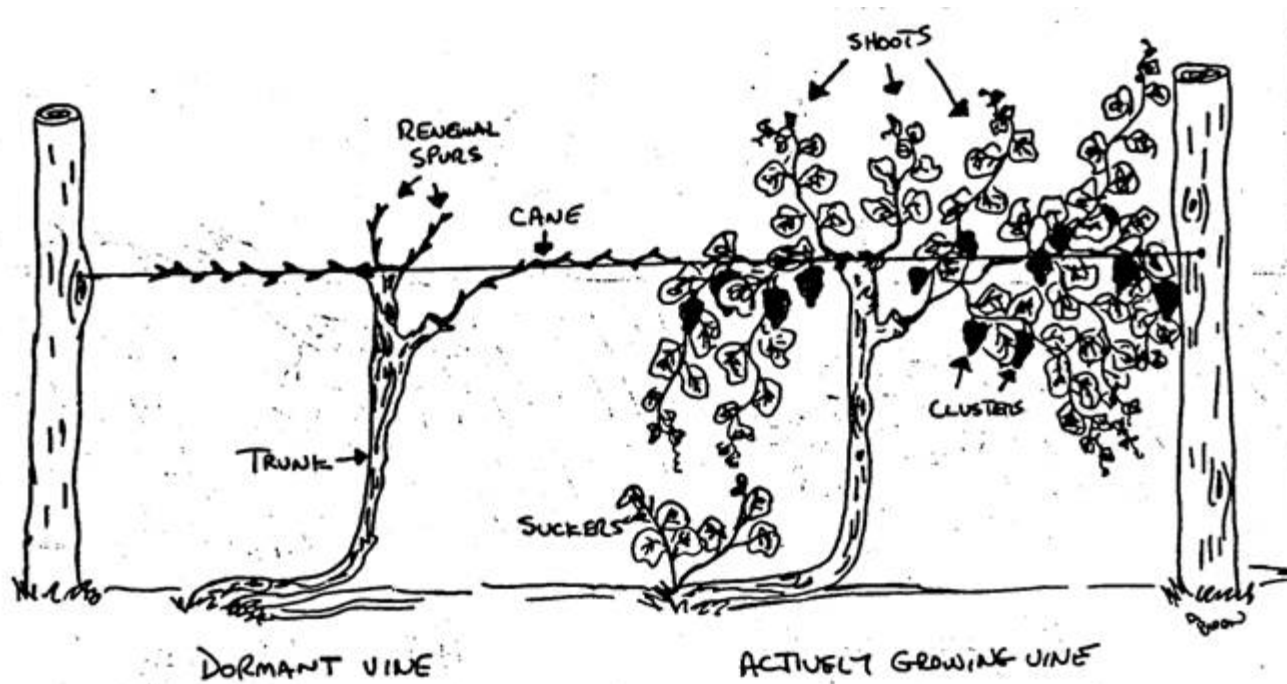


# Pruning



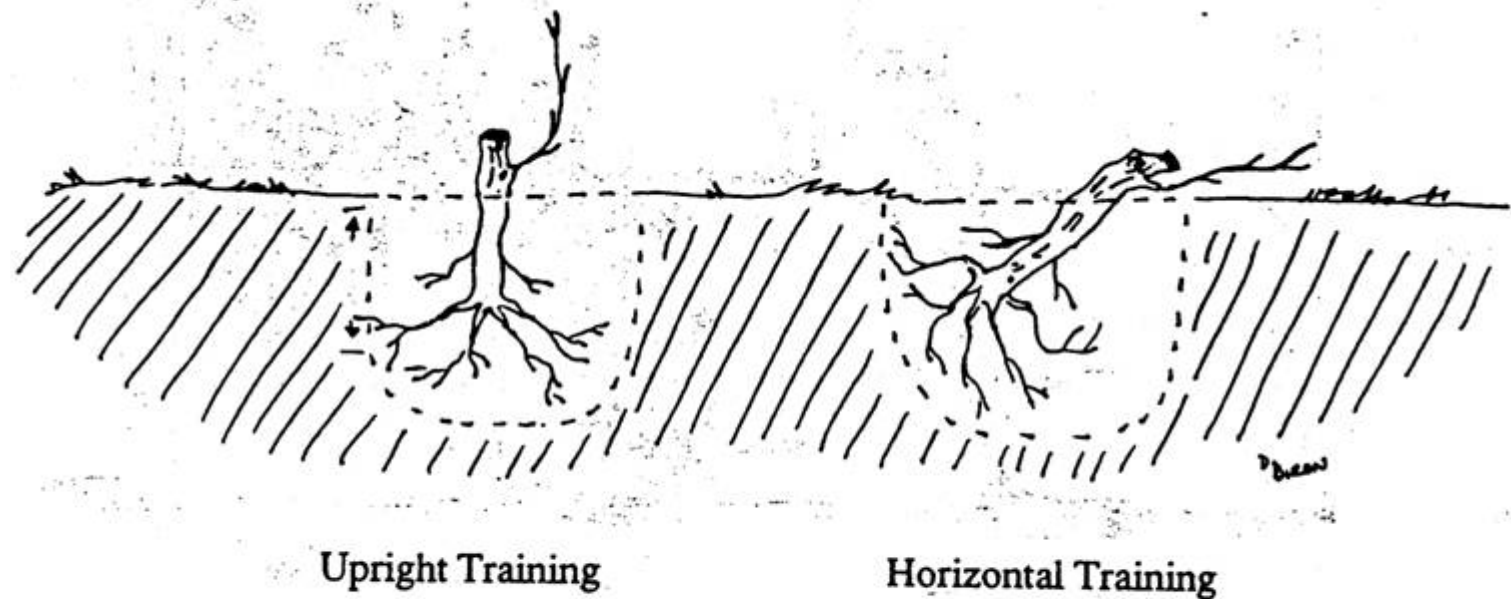
# Training System

## Lazy 'J' for Horizontal Lay-down



*FIGURE 3. Parts Of The Vine*

# Planting for Training System



*FIGURE 2. Setting Transplants*



# Before Spring Pruning





Save canes from last seasons growth...contains fruiting buds



# Spring Pruned



# Training a New Trunk

(Used to replace old/damaged)





# Summer Growth



# Summer Growth





# Summer Maintenance

- Shoot thinning @ 6" growth
  - 4-6 shoots per ft of canopy
- Shoot positioning (combing)
  - Direct shoots down (high wire)
  - or up (low wire)
  - or tie to wires (fan, kniffin)
- Cluster thinning
  - 1-2 clusters per shoot
- Hedging
  - Trim shoots when on ground or coming up over top wire

# Shoot combing





# Shoot combing





# Cluster thinning





# Cluster thinning





# Fertilizing

- Grapes perform best where the soil pH is between 5.5 and 6.5.
- Apply 8 ounces of 10-10-10 fertilizer per plant seven days after planting .
- Annually apply 11/2 pounds (10-10-10) per vine in the third and later years about 30 days before new growth begins in the spring.
- Do not concentrate fertilizer at the base of the trunk. Keep fertilizer 6 to 12 inches from the trunk and spread evenly under the spread of the vine.

# Weed Management/Mulch

- For best vine performance, avoid using thick organic mulches...heat is needed for growth.
- Use tillage, herbicides or black plastic mulch to control weeds.





# Summer growth, year 2



# Herbicide Injury





# Diseases

- Common grape diseases are **black rot, downy mildew, powdery mildew, anthracnose, phomopsis cane and leaf spot**, and botrytis bunch rot or gray rot.
- Proper spacing for air circulation, inoculum removal
- Spray program: <http://ohioline.osu.edu/b780/b780.pdf>





# Insects

- Major insects and mites on grapes are **grape berry moth**, **Japanese beetle**, grape flea beetle, European red mite, grape root borer, and grape phylloxera.



# Summary of Cultural Practices

- Select cultivars to match your climate
- Train vines for winter and summer
- Weed control, black plastic
- Fertilize before spring growth begins
- Prune annually
- Winter care: hardy cultivars, otherwise lay-down and rely on snow mulch or bury.

# Table Grapes- *Hardiness*

- Valiant
- Beta (Alpha)
- King of the North
- Bluebell
- Swenson Red
- Eidelweiss
- Other Swenson cvs.
- Worden
- Fredonia
- Concord
- Somerset Seedless
- Trollhaugen

# Table Grapes- *Maturity*

- Valiant (late Aug.)
- Beta
- Swenson Red (early Sept.)
- Bluebelle (mid to late Sept.)
- Eidelweiss
- Suelter (late Sept.)
- King of the North
- Worden
- Somerset Seedless
- Trollhaugen
- Mars
- Vanessa

# Wine Grapes

- St Croix
- St. Pepin
- Lacrosse
- Kay Gray
- Petite Pearl
- Frontenac
- Prairie Star
- Louise Swenson
- Swenson White
- Corot Noir (Tender)
- Leon Millot
- Marquette