

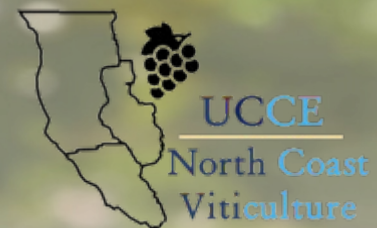
# Table Grapes at Home

| Strategies for vine health and pest control |

Christopher Chen, Ph.D.

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UCCE North Coast Viticulture



# Grapes – A history



# Grapes – A history

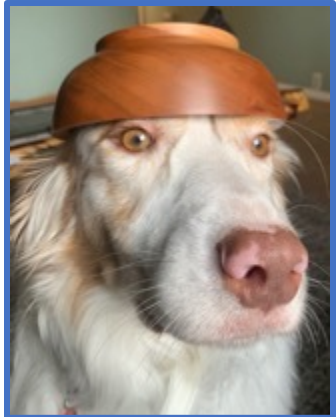


Dogs  
Domesticated

30,000  
BCE

2022  
CE

# Grapes – A history



Dogs  
Domesticated



Wheat  
Domesticated

30,000  
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8,500  
BCE

2022  
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# Grapes – A history



Dogs  
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Cows & Sheep  
Domesticated

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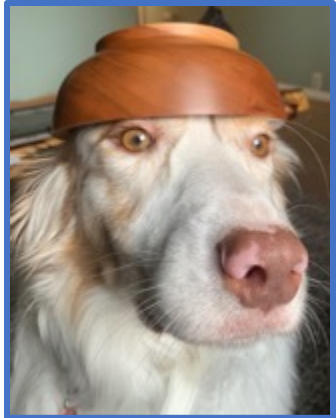


Wheat  
Domesticated

8,500  
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2022  
CE

# Grapes – A history



Dogs  
Domesticated

30,000  
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Wheat  
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Cows & Sheep  
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8,000  
BCE



Grapevines  
Domesticated

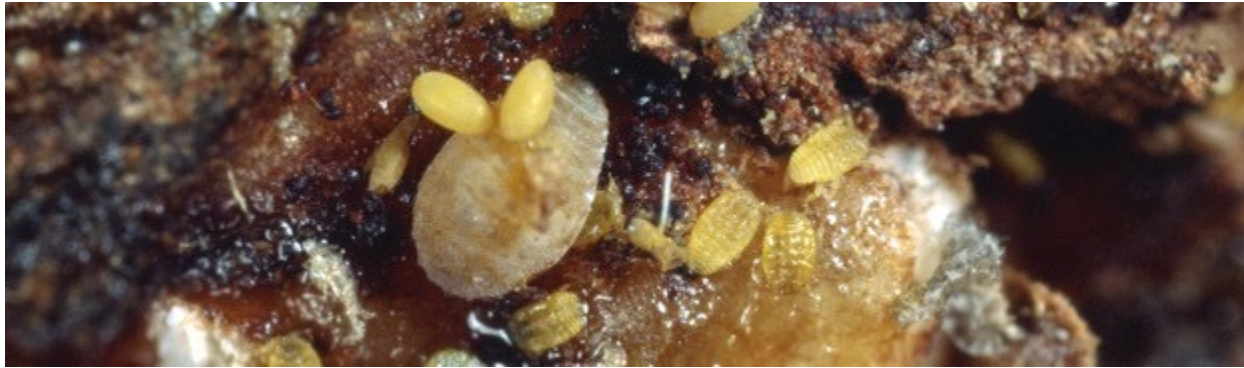
6,000  
BCE

2022  
CE

# Spread of *Vitis vinifera*

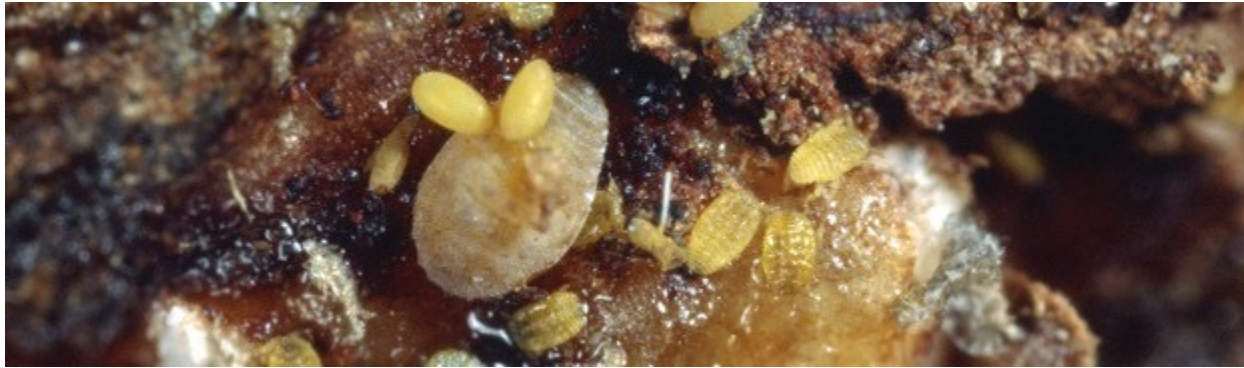


# Spread of Grapevine Phylloxera





# Spread of Grapevine Phylloxera



# Spread of Grapevine Rootstocks



# Spread of Grapevine Rootstocks



# Other Grapes

- North American (edible) Species

- Concord (*Vitis labrusca*) – Very common in Eastern U.S.
- Muscadine (*Vitis/Muscadinia rotundifolia*) – Popular in Southern U.S.
- Mustangensis (*Vitis candicans*) - ‘Mustang’ Wines

- North American Rootstock Species

- Several hundred species
- Big 3:
  1. *Vitis rupestris*
  2. *Vitis riparia*
  3. *Vitis berlandieri*

# Viticulture at Home

- One grapevine can produce **10 – 40 lbs** of fruit
- Sugar content at harvest should be between **18-22 °Brix**

Product	Serving	Sugar Content
Hershey's Bar	1 bar	17 grams
Coca-Cola	1 liter	106 grams
Grapes (18 °Brix)	1 liter (juice)	170 grams

- Average lifespan of a grapevine  $\approx$  **20-30 years**

# Home Management of Table Grapes



# Necessary Tools



**Refractometer**

- Measures sugar levels



**Pruning Shears**

- Structure the vine
- Remove infected tissue



**Jeweler's Loupe**

- Identify pests



# Objectives of Winter Pruning

1. Remove unwanted buds on shoots
2. Select desirable buds for fruit production
3. Establish growth patterns for Spring
4. Check for infection
5. Encourage or discourage vegetative vigor (vine balance)
6. Correct for over- or under-cropping from previous year
7. Avoiding frost damage (late pruning)





# Proper Technique

## Spacing

- Growing points on the fruiting cane (buds) or cordon (arms) should be  $\approx$  **6 in. apart**
- Proper spacing helps encourage air flow and spray penetration

## Cutting

- "Measure twice, cut once"
- Pruning cuts at an angle only
- Cut through terminal buds to prevent dieback
- Make sure your shears are **sharp** and **clean**



# Proper Technique

## Bud Count

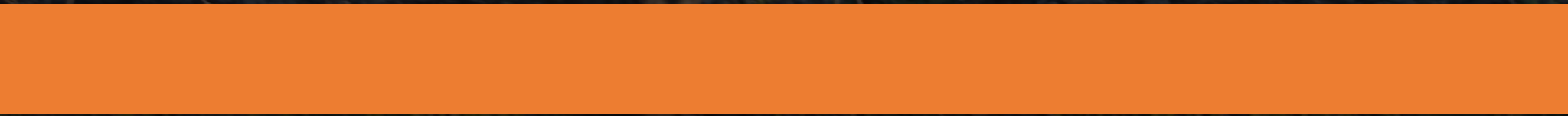
- Spurs should have **two visible buds** when pruned
- Fruiting Canes should have between **8-10 buds** when pruned
- Not a hard-fast rule; **adapt your bud count** to the vigor of your site and vine

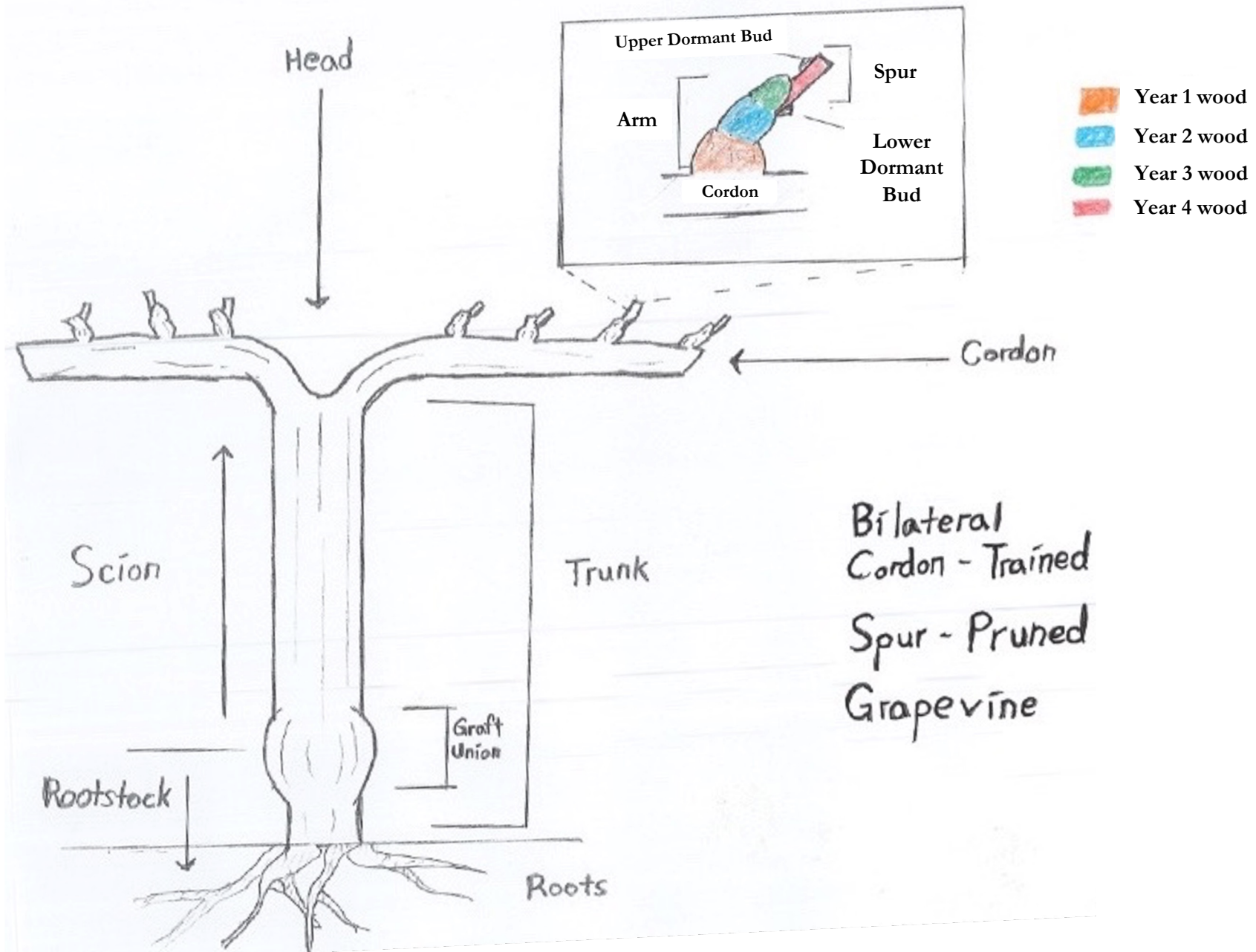
## Practice

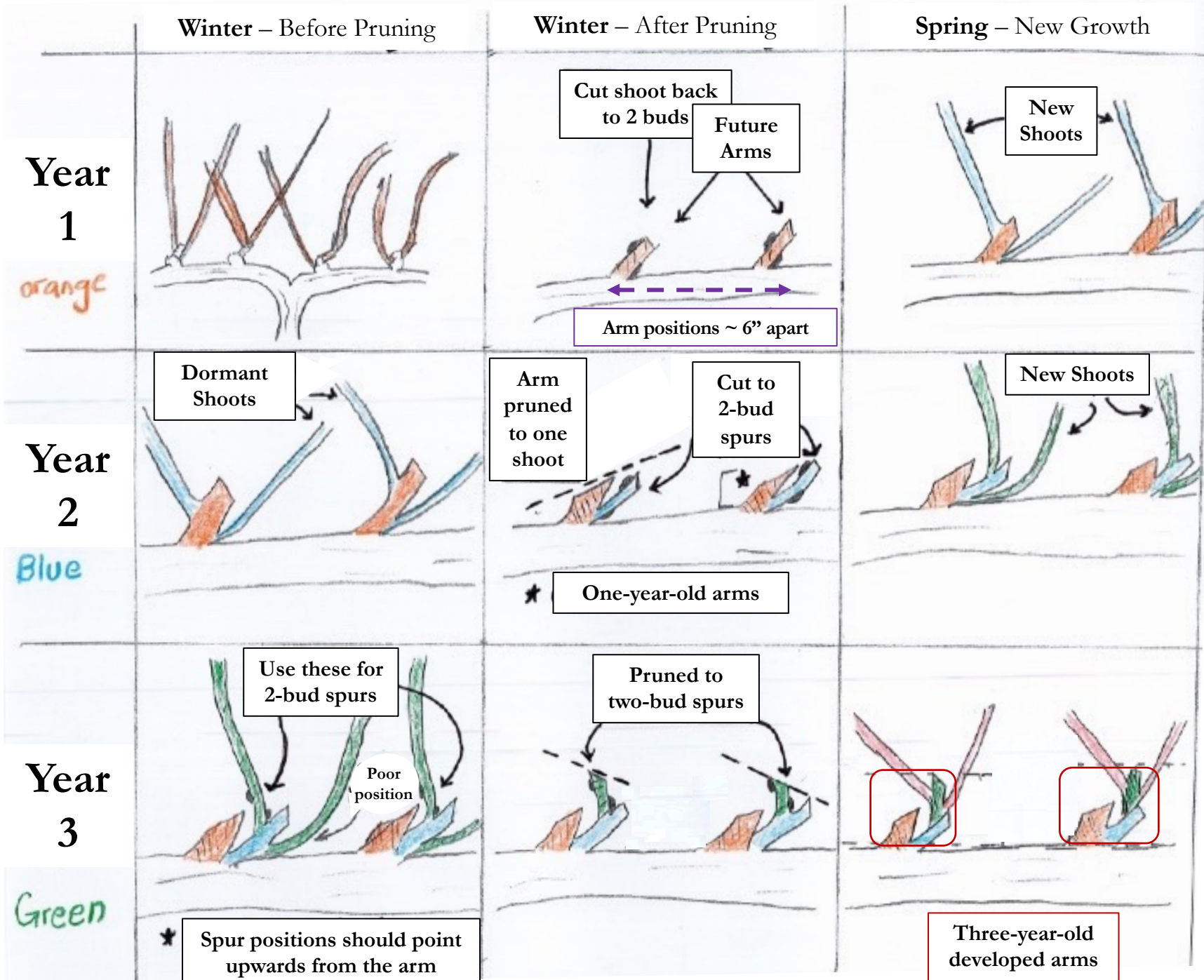
- It may be difficult to prune early on
- If you're not sure what to do, ask someone or try out the options on separate vines
- Every site and every vine are different



# Cordon-Trained Spur-Pruned

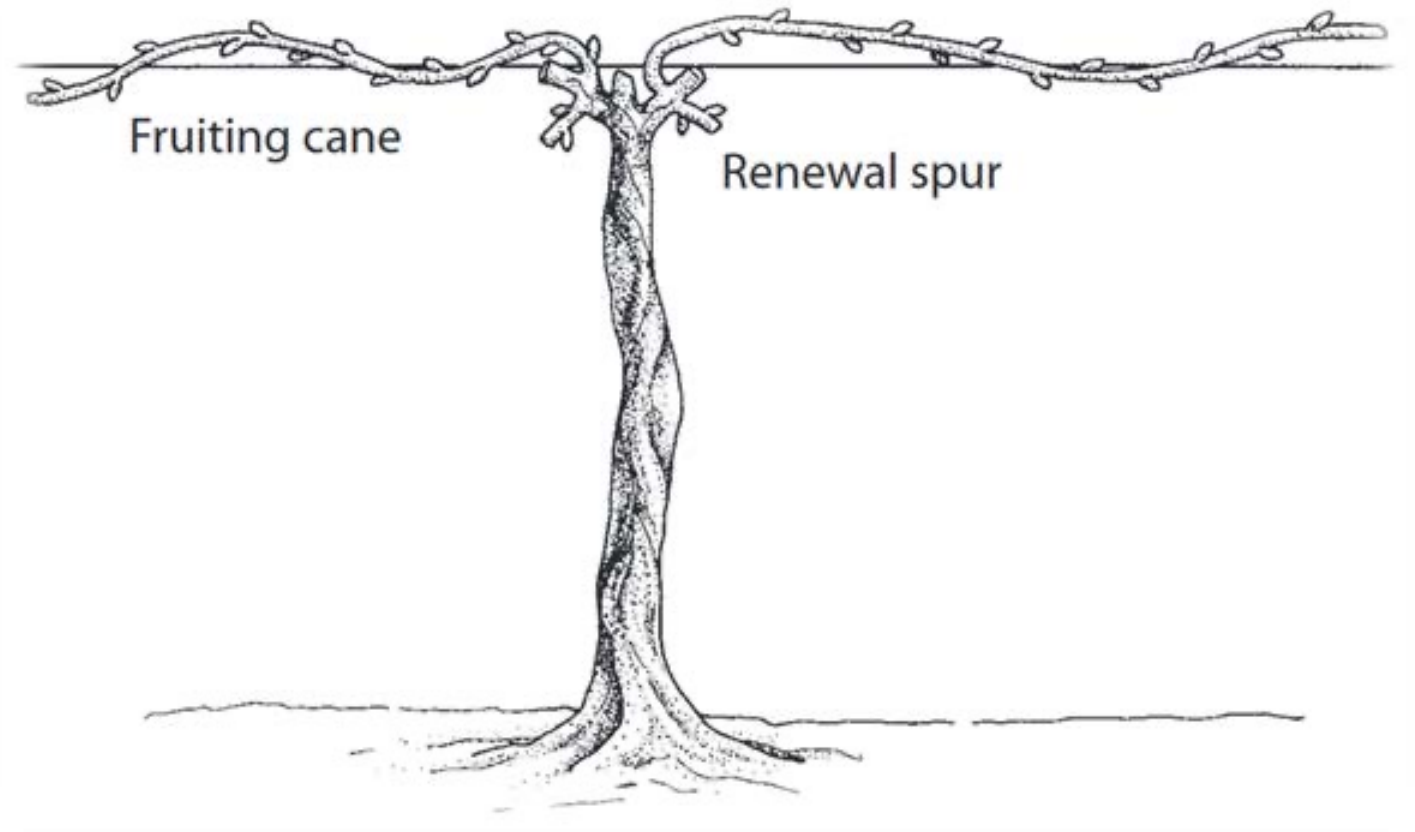






**Goals:** To have established growing positions and consistent yields

# Cane Pruned (Guyot Method)



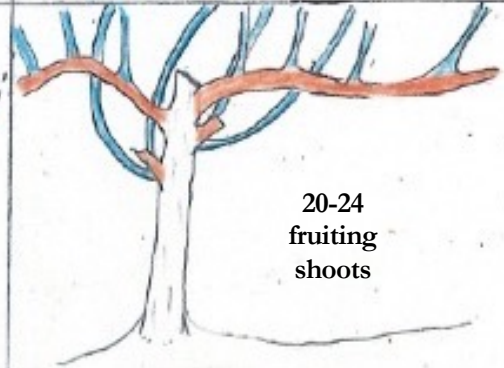
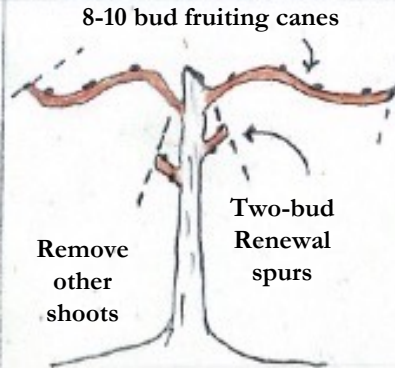
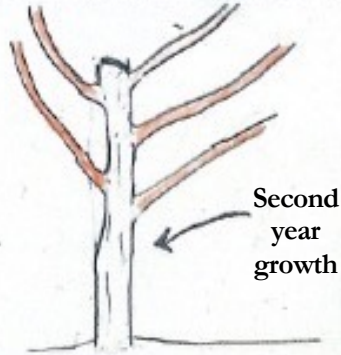
Training  
Year

Winter- Before  
Pruning

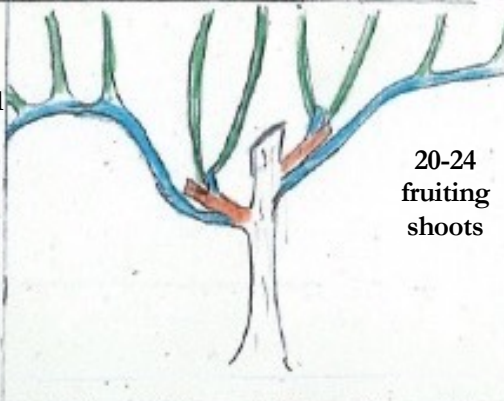
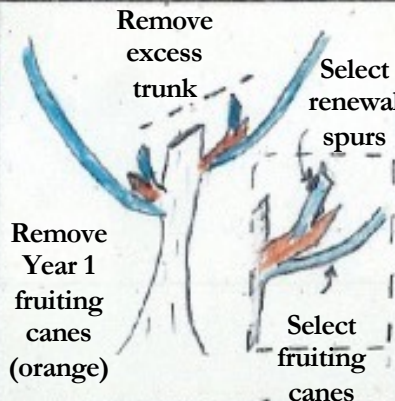
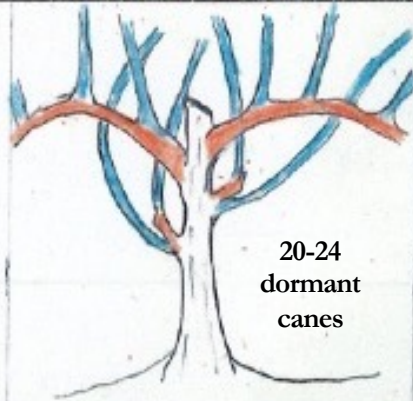
Winter- After  
Pruning

Spring  
Growth

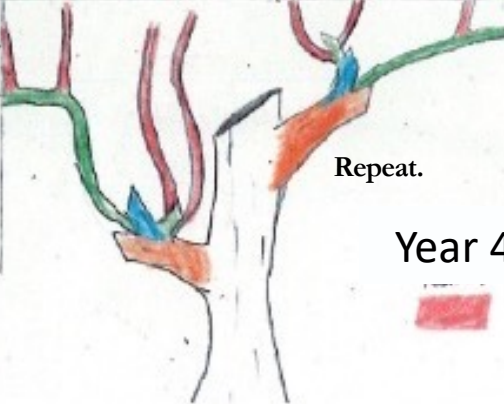
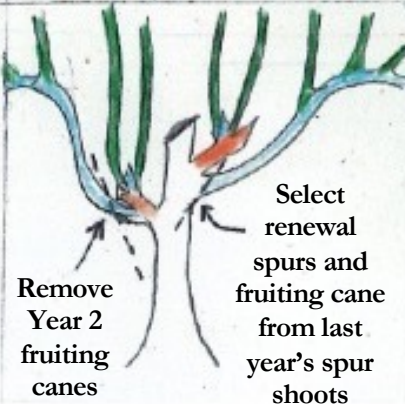
Year 1



Year 2



Year 3



**Goals:** To have less permanent wood and Devigorate the vine

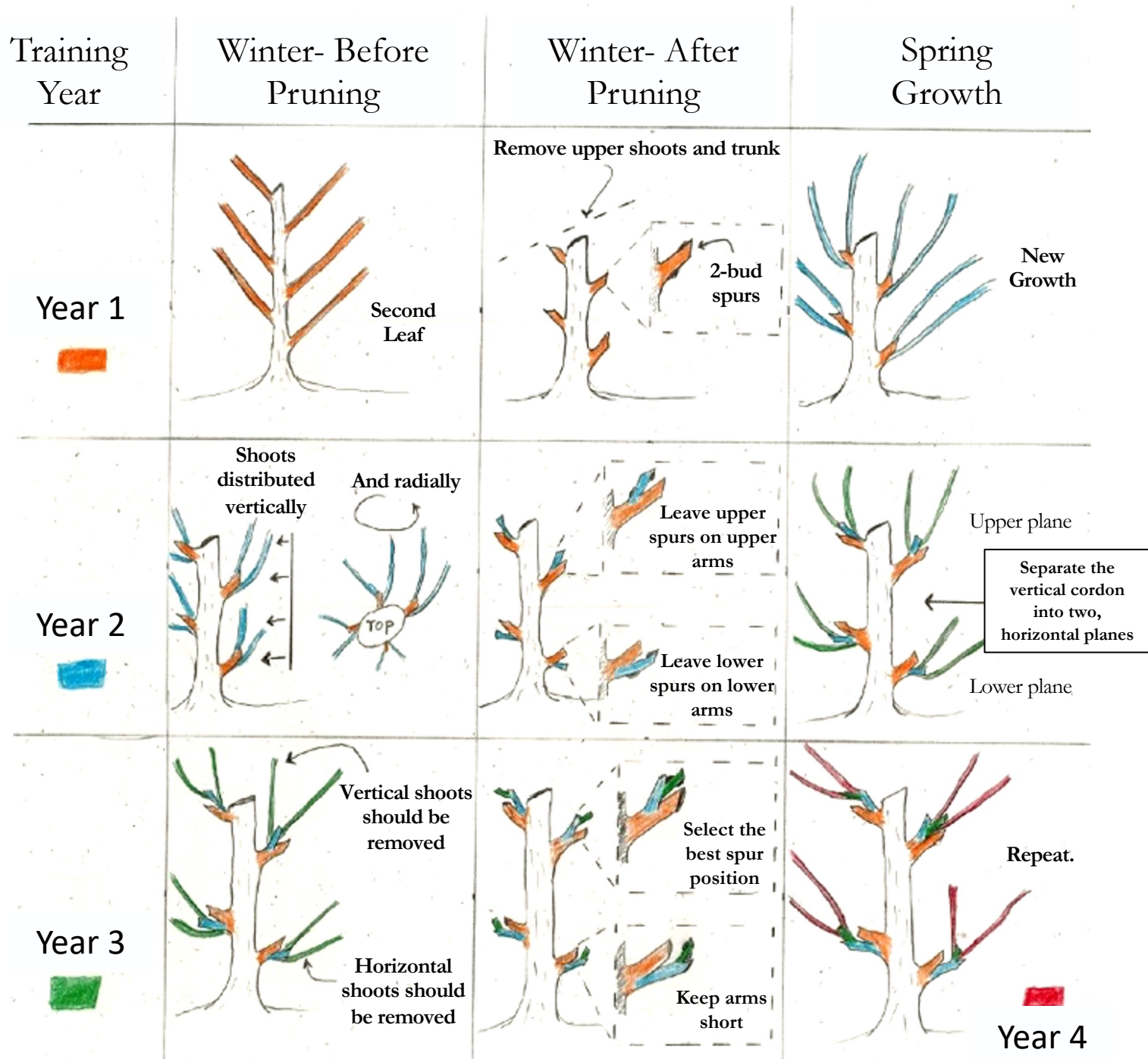
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# Head-Trained Spur-Pruned

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**Goals:** To have less infrastructure and supports while providing the grapes enough room to ripen

# Trellising / Support

- Goals
  1. Physically support the vines
  2. Provide space for fruit to ripen
  3. Make management easier
  4. Reduce 'permanent' wood



# Trellising / Support

- Supporting grapevines for home production
  1. Head Trained – Spur Pruned (Goblet)
  2. Trellis, Lattice, or Fence
  3. Pergola or Overhead



# Trellis, Lattice, or Fence

- Most common training
- Consistent Yields
- Easy to Manage
- Canopy can become too dense

Quadrilateral Systems



*geneva double curtain*



*scott henry*



*lyre*



*pergola*

Large Canopies



*basket / kouloura*

Impractical

# Pergola / Overhead

- Often used for shade
- Very effective for cluster development
- Inconsistent crop loads (year-to-year)
- Vine can be overcropped



# Managing Grapes at Home

1. One vine produces enough fruit for an entire family
2. Nearly all grapes are one species: *Vitis vinifera*
3. Training
  - Trellising not recommended for home growing
  - Head training or Pergola are easiest to manage
4. Always plant on a rootstock
5. Prune and shape it to fit your needs
6. Seeds are the most nutritious part of a grape
  - Consider planted a seeded Table Grape variety
  - They are much tastier 😊

# Main Management Goals

1. Keep the Canopy open
2. Remove any infected tissues
3. Strive for uniformity
4. Monitor regularly for pests & diseases
5. Avoid damaging the vine unnecessarily
6. Balance your vine's leaf area with fruit load
7. Build healthy soils



# Soil Amendments

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# Soil Amendments

- Some common soil amendments are compounds found in home gardens

## **Lime**

- Often used to increase soil pH

## **Gypsum**

- Improve water infiltration and provide Calcium

## **Compost**

- Added to improve the soil organic matter content, soil nutrient content and WHC

## **Manure**

- Added for the same reasons as compost

## **Mulch**

- Distributed on the soil surface for evaporation control and slow-release nutrients

## **Fertilizers**

- Applied regularly to replace nutrients lost due to harvest

## **Biochar**

- Can be used to improve soil WHC and nutrient retention

# Lime [(CaCO<sub>3</sub>) or CaMg(CO<sub>3</sub>)<sub>2</sub>]

Lime is often used to:

1. Increase the soil pH (more basic)
2. Provide Calcium in calcium-deficient soils

Liming also helps:

1. Provide Magnesium in Dolomite forms
2. Improve soil structure (aggregation)
3. Alter the availability of soil nutrients



# Gypsum [ $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$ ]

Gypsum is often used to:

1. Provide Calcium and Sulfur
2. Improve soil structure
3. Improve water infiltration into soils

Gypsum should be applied to the soil surface and not mixed in like Lime.

## **Timing**

If  $\text{pH} < 5$  consider adjusting to higher pH before applying Gypsum.



# Compost

Compost is often used to:

1. Incorporate essential nutrients
2. Increase Soil Organic Matter
3. Improve water and nutrient retention
4. Improve soil aggregation
5. Reduce soil erosion

Compost often contains most or all of the nutrients needed for plant growth and is a general nutrient amendment.

If a specific nutrient is required (e.g., potassium) it would be better to apply it as a fertilizer rather than increasing compost applications.



# Compost

Compost is often made out of:

1. Animal manure and plant matter
2. Custom compost using grape pomace

Types of compost:

1. **Raw** – hasn't gone through the entire composting process and often contains weed seeds, pathogen inoculum, or pests. Unpredictable, heterogeneous nutrient content.
2. **Finished** – more uniform color and texture with C:N ratio  $\leq 20$ . Doesn't contain pests and diseases as often.



# Compost

Application rates vary by site. However, nutrients in compost become available over time (slow-release).

For example:

- Approximately **30-50% of the Nitrogen** content of the compost will eventually become available to the plant. About  $\frac{1}{2}$  of that will be accessible in the first year after compost is incorporated and the rest over the next few years.

Apply in Spring to avoid Nitrogen leaching from rains



# Manure

- Applied for the same reasons as compost.
- Rarely applied on its own in vineyards.
- Manure is most often mixed with straw bedding to create a raw or finished compost before application.
- Apply in Spring when the vine can take up the most Nitrogen



# Mulch

Mulch is commonly applied to the top of the soil and often used for:

1. Erosion control
2. Weed suppression
3. Reduces soil evaporation
4. Gradual nutrient additions





# Fertilizers

Fertilizers are by-far the most common soil amendment.

They are used to:

1. Replace nutrients lost through harvest
2. Improve vine vigor and health
3. Increase yields per acre
4. Improve success rates of fruit set and other phenological events



# Fertilizers

- Fertilizers are not all pure nutrients. Make sure to calculate how much of the nutrient your targeting is in the fertilizer
- This is true for all fertilizers and nutrients
- Make sure you know how much you need and how much you have before applying

## Common Fertilizers with Nitrogen:

Fertilizer	Chemical Formula	Percent of Fertilizer that is pure N:
Anhydrous Ammonia	$\text{NH}_3$	82% N
Urea	$\text{CH}_4\text{N}_2\text{O}$	46% N
Ammonium Nitrate	$\text{NH}_4\text{NO}_3$	34% N
Ammonium Sulfate	$(\text{NH}_4)_2\text{SO}_4$	21% N

# Fertilizers

If you need:

- 3 lbs/acre of pure N
  - 6.5 lbs of Urea
  - 15 lbs of  $(\text{NH}_4)_2\text{SO}_4$
- You need twice as much Ammonium Sulfate as Urea to get the job done
- Which is more expensive per pound?

## Common Fertilizers with Nitrogen:

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# Pests and Diseases of Grapevines

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# Major Fungal Diseases of Winegrapes

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UCCE Integrated Vineyard Systems Advisor

# About Fungi – In/on the Vine

- **Mycorrhizae** – Not all fungi are bad!
- Lots of bad ones for grape production though:
- Can result in:
  - Losses of Vigor
  - Fruit Damage
  - Decreased Yields
  - Vine Death

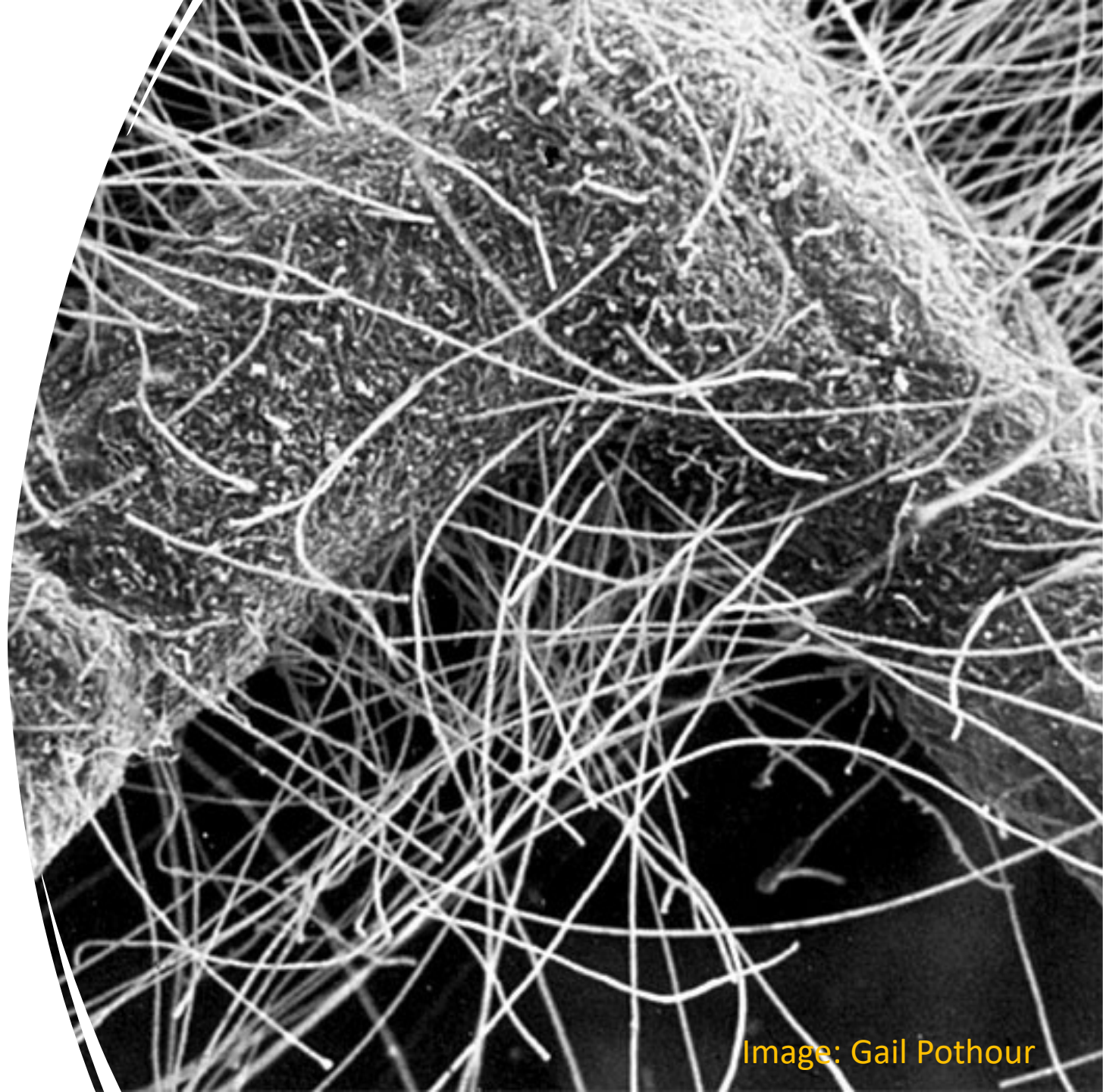
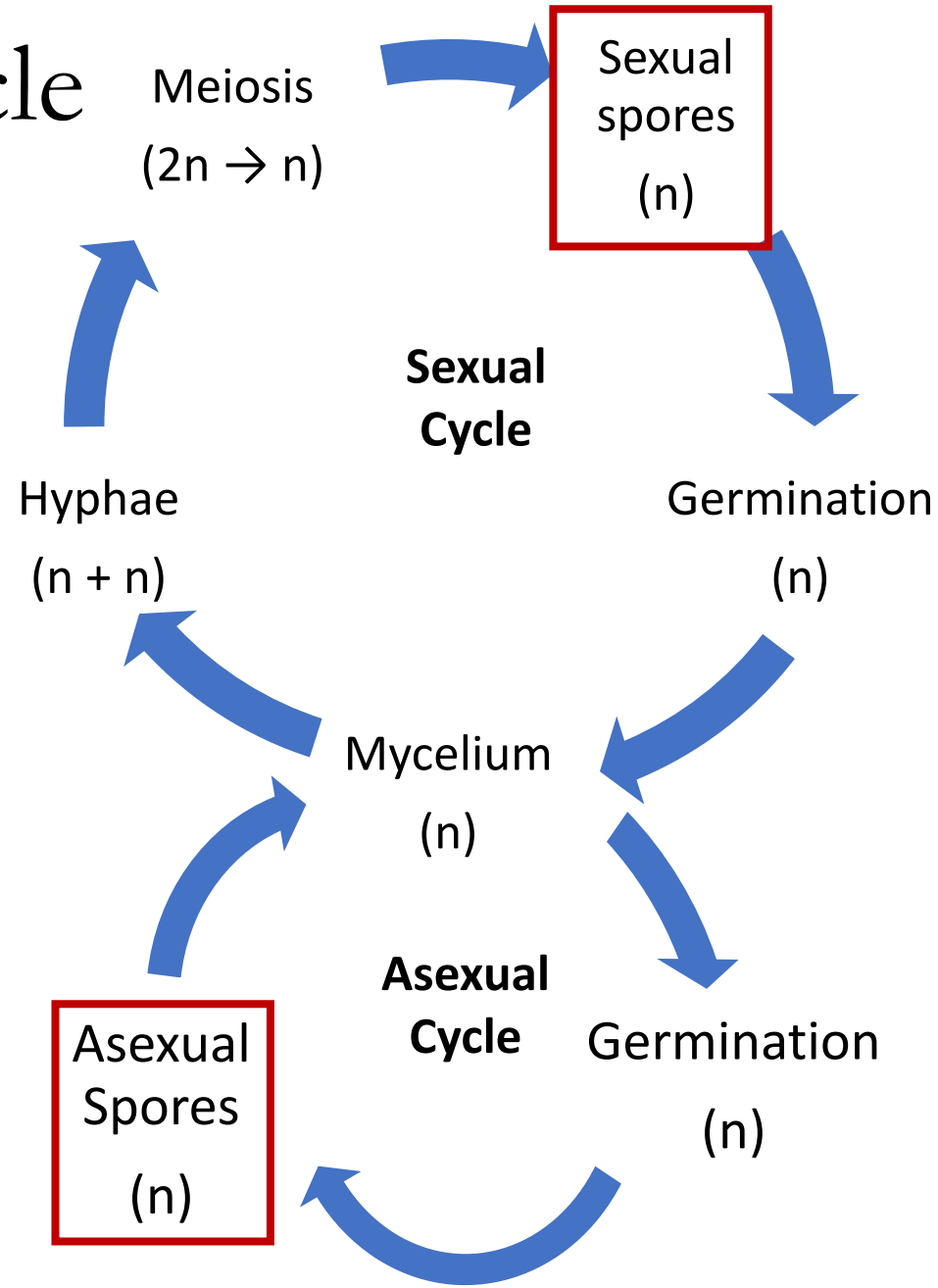


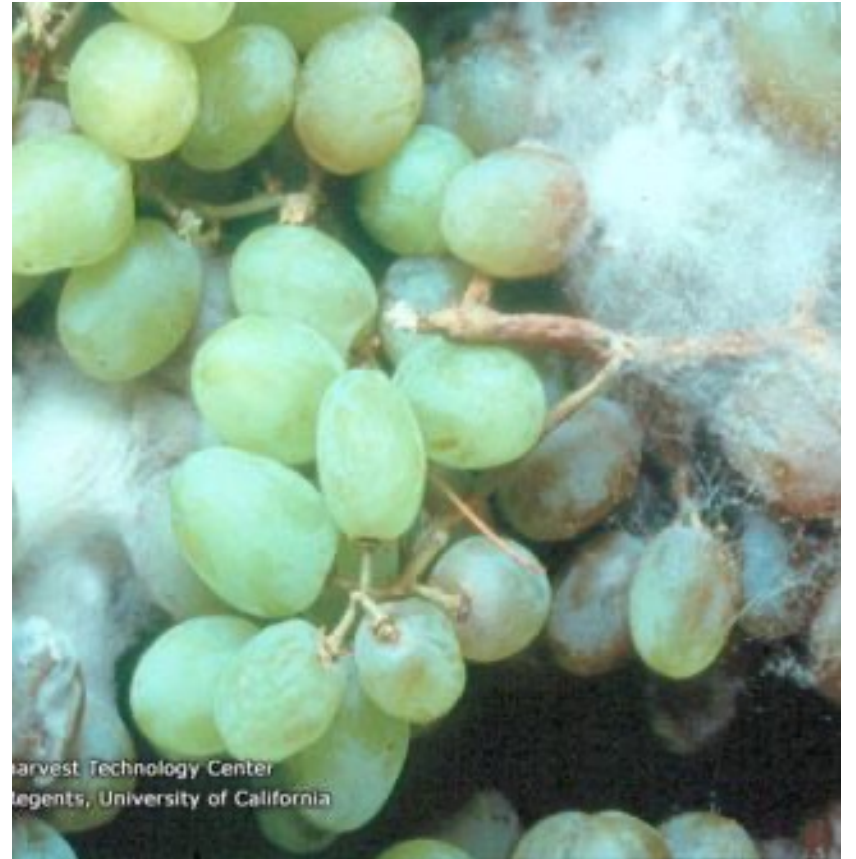
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# Fungi Lifecycle



# Fungi - Conditions

- Spores + Free Water = Spread
- Ideal Conditions
  - Most fungi require temperatures below a certain maximum to thrive
  - Global warming has raised temperatures across the world
  - Recently, fungi have started to evolve to tolerate warmer ambient temps
- Case Study: *Candida auris*
  - Simultaneously emerged on three separate continents within three years!
  - Suggested as an early example of a pathogenic fungi adapting to climate change







# What tissues are impacted?

- This is important to address when identifying fungal pathogens
  - Different fungi infect and impact different tissue types
- Most common sites to note are:
  - Trunk and permanent wood fungi
  - Foliar (leaf tissue)
  - Fruit (clusters)
  - Roots
- Many fungi infect more than one tissue type, but are more visible on one



# How old are vines that display symptoms?

- Important for identification and source of infection
- If the vines are very young, consider if it came from the nursery
  - Must observe to see if any older vines have symptoms first
  - Was it present in the vineyard before you planted the young vines?
- Older, symptomatic vines could be due to a slow-moving fungi
  - This is common with Grapevine Trunk Diseases (5-10 years before symptomatic)



# What does the pattern of spread look like?

- Look at your entire vineyard or garden
  - Draw a map
- Where was the first symptomatic vine
  - Label it on the map
- Where did the disease progress?
  - Often it starts near a tree-line
  - Is it a circular pattern of spread or does it hop across multiple rows?



# Talk to Your Neighbors

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- Talk to your neighbors
- Sometimes other crops and garden ornamentals can harbor fungi
- What have they noticed in their plants?
- Neighbors are the #1 source of information for localized concerns!



# What are the ideal conditions for it to spread?

➤ Conditions to make note of:

- **Relative humidity** – does the fungi spread better in humid or dry conditions?
- **Temperature** – Is expression of the disease more or less in very hot years?
- **Time of expression** – What time of year do you notice the symptoms the most?
- **Location of signs/symptoms** – In the canopy, on trunk, shoots?
- **Precipitation** – Does it spread more in wetter years?
- **Management practices** – Does it spread more in years of high pruning volume?

# How long has it been present in the vines?

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- Can help estimate how much the pathogen has spread
- Helps inform management decisions to control the fungi



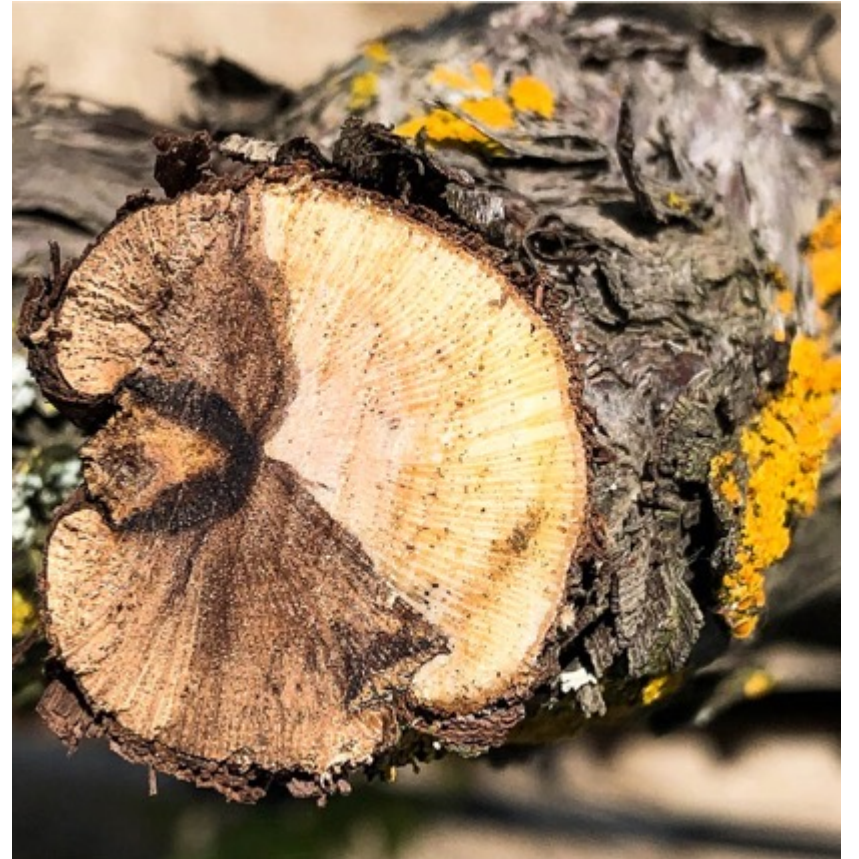
# What management options are available?

- Confirm the identity of the fungal pathogen with an expert
- Research management options for that specific fungi
- Practices that are non-destructive are often preferred
- Although destructive practices are not always avoidable



# Can it be controlled easily or not?

- Sometimes management options can reduce pathogen pressure a lot
- Example of Botrytis Bunch Rot (semi-easy to control):
  - Remove leaf layers in spring to open up the canopy
  - Use Sulfur based fungicides to minimize the spore counts
  - Allow for sufficient air flow in the canopy
  - Try to keep clusters from getting densely packed
  - Reduce insect or vertebrate feeding on ripe grapes
- Example of Eutypa (difficult to control):
  - Takes a long time to express itself
  - Could have spread a lot by the time you notice it
  - Requires grower to cut the vine back, past the point of initial infection to control



# Common Diseases to Watch For

# Trunk Diseases



# Eutypa

- Wedge-shaped wood cankers form in infected wood
- Dead spurs and shoot dieback
  - Symptoms shared among multiple trunk diseases
- Dwarfed, chlorotic leaves, sometimes with a cupped shape and/ or tattered margins
- Delays shoot emergence in Spring



# Botrytosphaeria (Bot Canker)

- Most common trunk disease in California
- Causes death of spurs, arms, cordons, canes, and upper trunk
- Wedge-shaped wood cankers form in infected wood
- Leaves will wilt and infected shoots will dieback completely
- Other symptoms: dead spurs, stunted shoots, and bud mortality



# Esca

- Complex of fungi that includes three different *Phaeoacremonium* species
- Foliar symptoms = interveinal stripes
  - Start out as dark red in red cultivars and yellow in white cultivars, dry and become necrotic.
  - Prevalent in July and August
- Spores released during fall/spring rainfall and infect pruning wounds
- Pruning wounds susceptible to infection for several weeks
- Cannot be eradicated by fungicide applications (like all trunk diseases)



# Phomopsis (Cane and Leaf Spot)

- Same as all the other trunk diseases
- Look for black/brown spots on canes
- Often symptoms occur when rain falls after budbreak



# Managing/Controlling Trunk Diseases

- Late Pruning or Double-Pruning
- Clean your equipment before and after each use
- Remove infected wood and retrain trunk
- Paint large pruning wounds with protectant
  - *Trichoderma* Based biological fungicides (Vintec, Bio-Tam, Crab-Life)
  - Can help control *Eutypa* (*E. lata*) and *Botryosphaeria* Dieback (*N. parvum*)



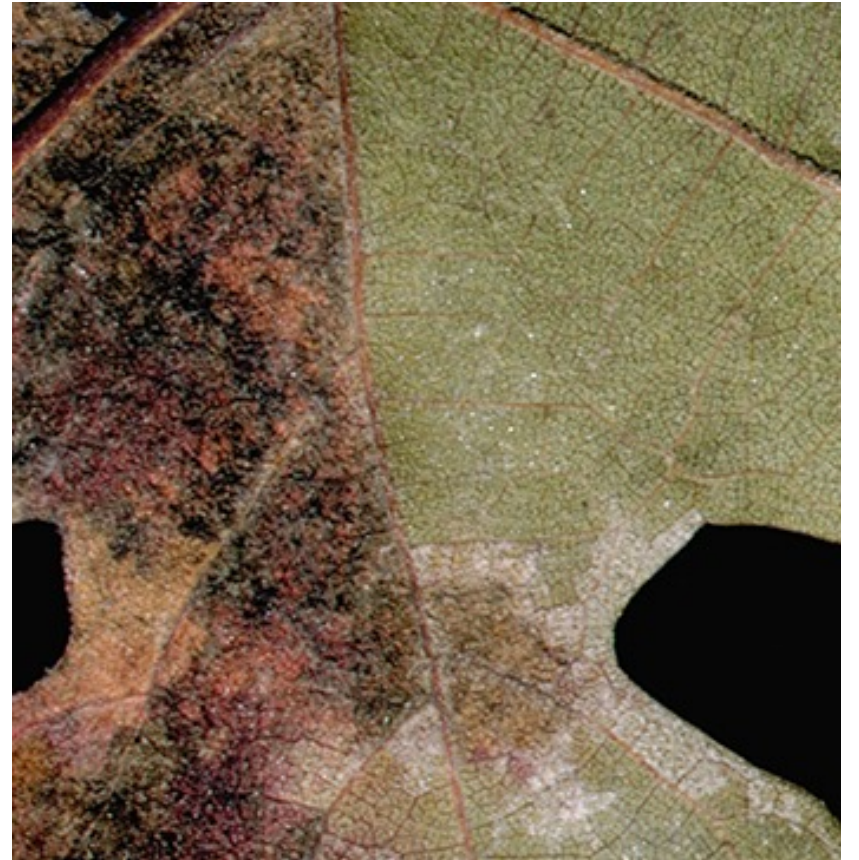


# Mildews



# Downy Mildew

- Attacks all green parts of the vines, particularly the leaves
- Not common in California
- Signs are a delicate, dense, white, cottony growth in the lesions
- Infected shoot tips thicken, curl ("Shepherd's Crook") and become white with sporulation. Eventually die
  - Similar symptoms on petioles, tendrils and inflorescences
- Young berries and the cluster rachis are highly susceptible.
  - Appear grayish when infected (gray rot) and become covered with a downy felt of fungus sporulation.



# Powdery Mildew

- Overwintering = Mycelia in dormant buds or Chasmothecia (fruiting bodies)
- Warm winter or spring days cause Chasmothecia spores to germinate
- Conidial spore production occurs 7 to 10 days after primary infection by chasmothecia ascospores
- Limit of around 85°F for reproduction and growth



# Powdery Mildew

- First appears on leaves as chlorotic spots on the upper leaf surface
- Visible signs = White, webby mycelium on the lower leaf surface
- Infected areas have a white-powdery or dusty appearance
  - On leaves and fruit
- Black/Brown scarring = signs of a former colony

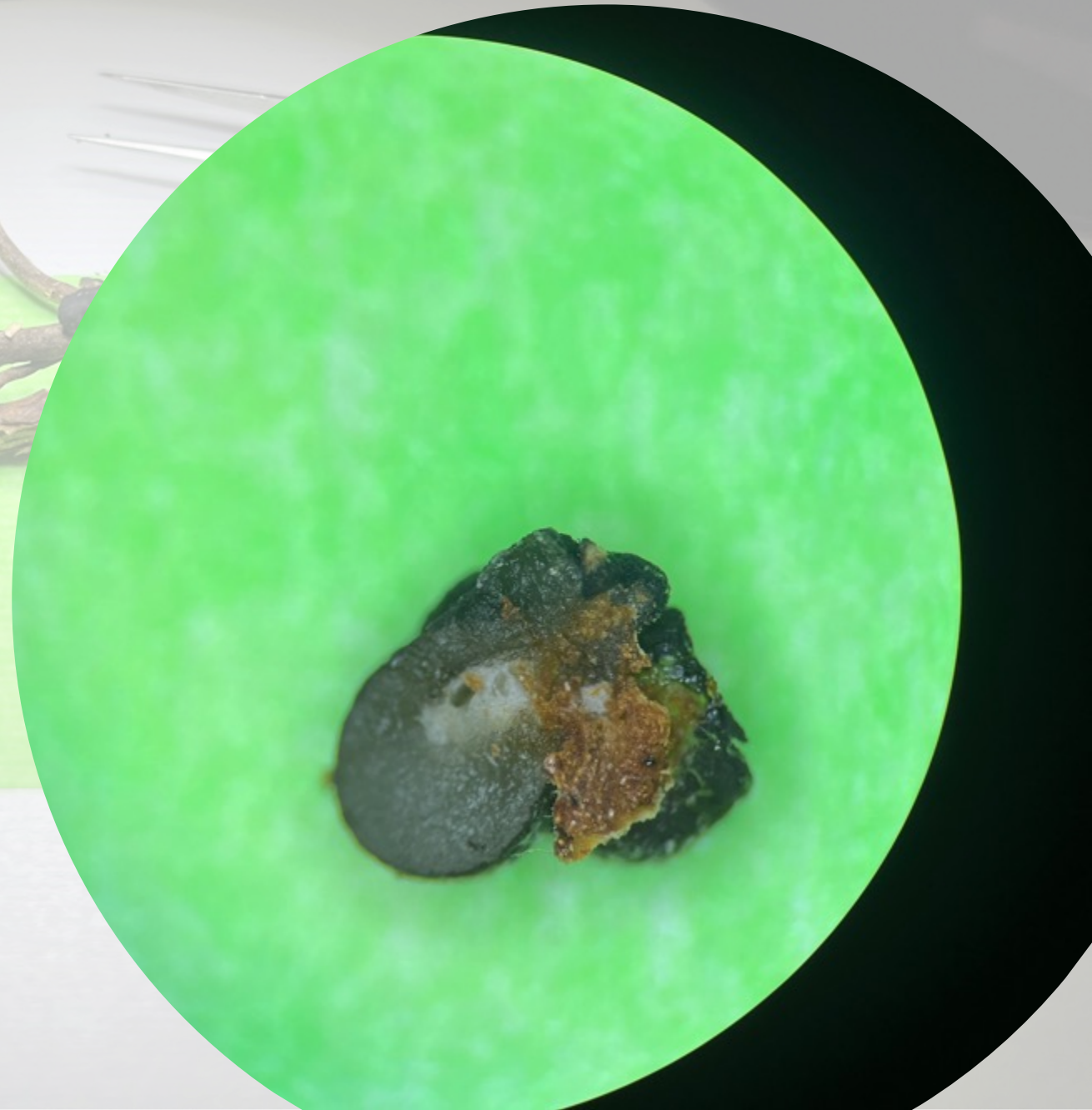


# Managing Mildews

- Keep things dry!
  - Effective soil drainage and reduction of sources of overwintering inoculum
- Leaf removal by itself can result in 50% disease control
- Preventive fungicides must be applied before an infection period begin
  - Early season copper sprays
  - Apply a contact material as soon as possible to eradicate those colonies prior to the onset of conidial spore production
- Micronized sprayable sulfur application or oil should be applied prior to other fungicides



# Root Fungal Diseases



# Armillaria Root Rot

- Indigenous in many regions and affects many perennial plants
- The vegetative stage of the fungus (mycelium) survives on infected, decaying roots below ground, potentially for many years
- Prefers soils that are continuously wet during the growing season
- Mushroom fruiting bodies produce spores
  - Spores are not a 'significant' source of disease spread
  - Mycelium spread the disease more readily





## Summer Bunch Rot (Sour Rot)

- Bunch rot pathogens often results in ‘Sour Rot’
- Spore masses develop on berry surfaces after infection
- Symptoms include hairline cracks in the berry skin, watery discoloration of berries, and general berry breakdown
- *Alternaria tenuis*, *Aspergillus carbonarius*, *Aspergillus niger*, ***Botrytis cinerea***, *Cladosporium herbarum*, *Penicillium* sp., *Rhizopus arrhizus*



# Botrytis Bunch Rot

- Produce **balanced canopies** with moderate shoot vigor
- Canopy management practices
  - **Shoot thinning, hedging, and leaf removal** Improves fungicide contact and efficacy
- Infection requires Free-Water (watch out if it rained)
- Apply sprays before rainfall especially at bloom or after veraison
- Avoid unnecessary irrigation or nitrogen fertilization that may promote excessive canopy growth.



# Fungi and the tissues with symptoms/signs

Trunks	Leaves	Fruit/Inflorescence	Canes/Shoots	Roots
Eutypa	Downy Mildew	Downy Mildew	Eutypa	Armillaria
Phomopsis	Powdery Mildew	Powdery Mildew	Phomopsis	
Esca	Esca	Esca	Esca	
Bot Canker	Phomopsis	Summer bunch rots	Powdery Mildew	
		Botrytis Bunch Rot	Botrytis Bunch Rot	
		Phomopsis	Bot Canker	

# Virus and Viroids

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# Major Viruses of Grapevines

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1. Red Blotch (GRBaV)
  - Spread by Three-Cornered Alfalfa Hopper
2. Leaf Roll (GLRaV)
  - Spread by Mealybugs and Scales
3. Fan Leaf (GFLV)
  - Spread by Dagger Nematodes
4. Corky Bark
  - Spreads slowly in vineyards; graft spread



# Impact of Viruses on Grapevines

## 1. Red Blotch (GRBaV)

- Red/bleached leaves = loss of photosynthetic area
- Poor sugar accumulation and late ripening



# Impact of Viruses on Grapevines

## 1. Red Blotch (GRBaV)

- Red/bleached leaves = loss of photosynthetic area
- Poor sugar accumulation and late ripening

## 2. Leaf Roll (GLRaV)

- Red/bleached leaves with cupped/curled margins
- Yield losses of 30-50%
- Poor sugar accumulation



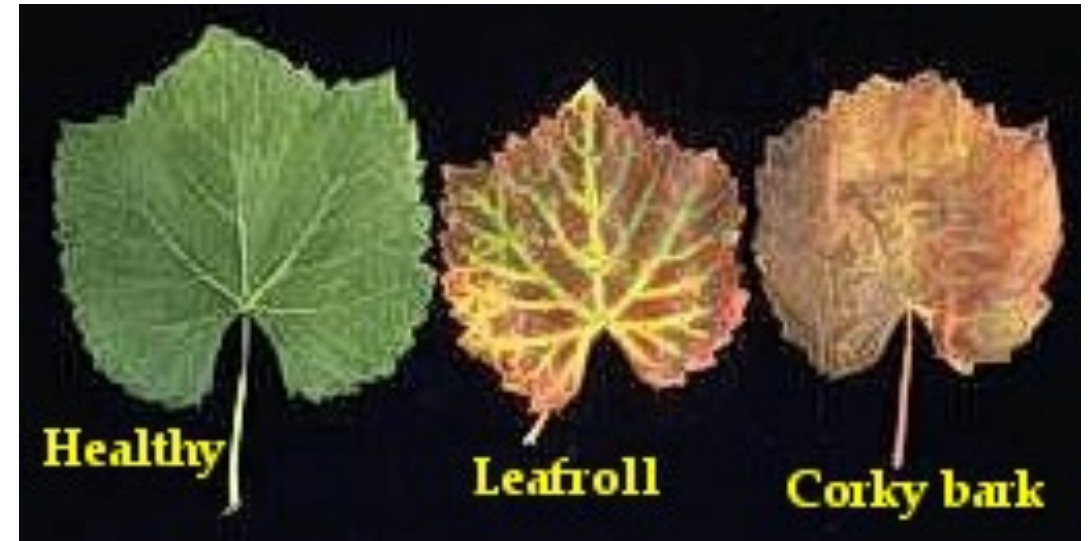
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  - Yield losses of 30-50%
  - Poor sugar accumulation
3. Fan Leaf (GFLV)
  - Leaf discoloration and foliar malformations
  - Poor sugar accumulation
  - Yield Losses



# Impact of Viruses on Grapevines

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3. Fan Leaf (GFLV)
  - Leaf discoloration and foliar malformations
  - Poor sugar accumulation
  - Yield Losses
4. Corky Bark
  - Cupped/Curled leaves
  - Uniformly dark red leaves
  - Often confused with Leafroll





# Bacteria

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# Pierce's Disease (*Xylella fastidiosa*)

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- Wiped out viticulture in S. California TWICE
- Spread by Sharpshooters (particularly Glassy-Winged)
- Colonizes xylem and blocks vascular flow

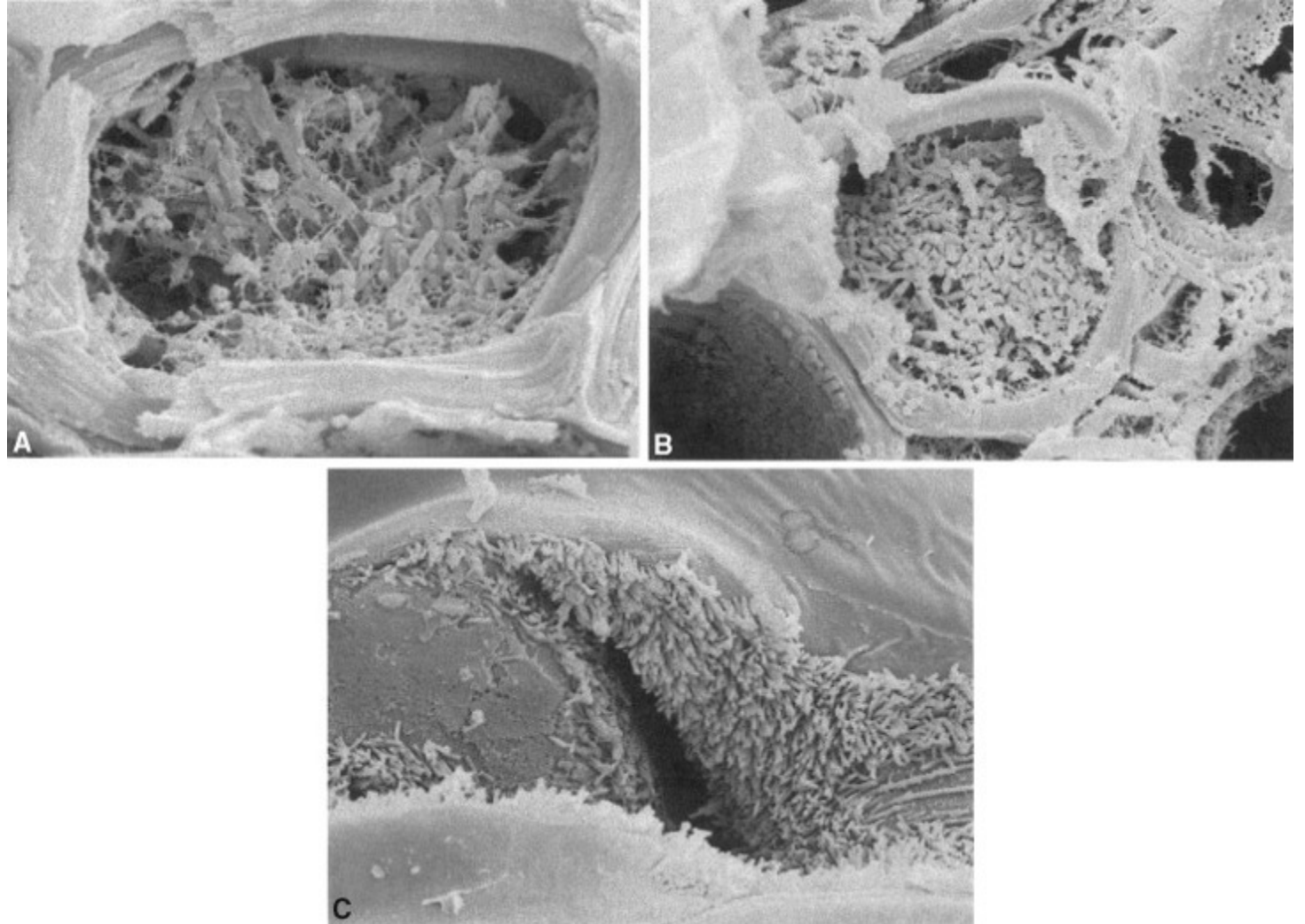


Image – Hopkins (2005)

# Crown Gall

(*Agrobacterium vitis*)

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- Present everywhere
- Often enters wounds on the vine
- Not a huge problem unless heavily infected



Management

# Management – Trunk Diseases

- Once infected, fungicides don't help
- Preventative strategies best
- Clean equipment
- Time pruning far separated from predicted precipitation



# Management - Mildews

- Open canopies help a lot
- Leaf removal allows for better air flow and spray penetration
- Avoid excess irrigation and fertilization
- Sulfur or copper-based fungicides



# Management – Bunch rots

- Open canopies
  - Good air flow and spray penetration
- Reducing cluster density
  - Based mostly on variety (e.g., Pinots are very dense, Cab Sauv is not)
  - Can reduce berry sizes through irrigation to prevent large, squished clusters
- Sprays and fungicides
- Avoid damaging clusters after veraison
- Remove any mummies (dried berries)



# Management - Viruses

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- Control the insect and nematode vectors
- Once infected, there's little to be done
- Always monitor the symptoms





# Management - Bacteria

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- Control the insect and nematode vectors
- Determine if the vine and crop will suffer from the pathogen
- Remove any vines that show severe symptoms

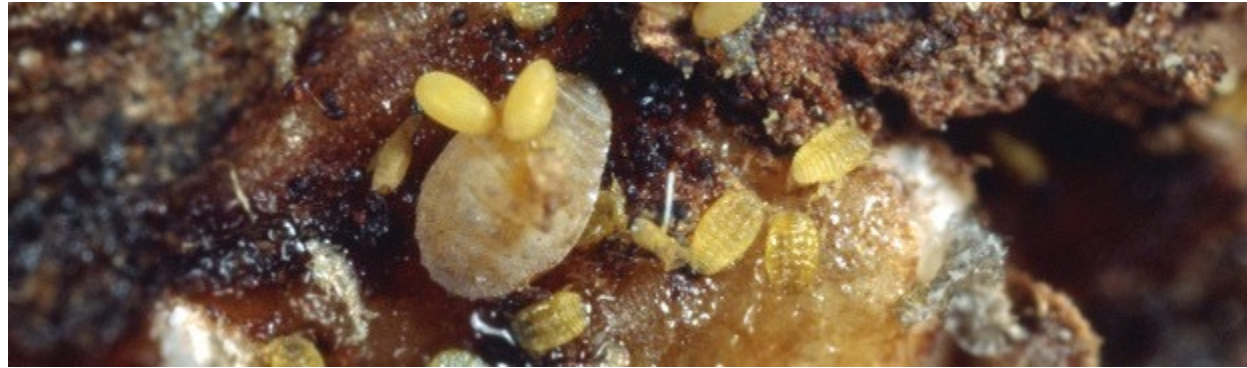




Common Pests in Vineyards



# First Pestilence - Grapevine Phylloxera



# Mealybugs and Ants

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- Grape and Vine Mealybugs
- Commonly tended to by ants
- Look under the bark strips or follow ant trails



# Sharpshooters

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- Blue-Green Sharpshooters
- Glassy-Winged Sharpshooters
- Vector Pierce's Disease
- Like riparian habitats



# Leafhoppers

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- Feed directly on vines
- Can kill a vine in large numbers
- Grape, Variegated, and Virginia Creeper
- Benefit sooty mold growth



# Spotted Lanternfly

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- May become a problem in CA
- Feed on grapevines
- Alternative host = Tree of Heaven



# Pest Damage

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- Some are phytophagous and feed directly on the grapevine
- Some are vectors of other diseases, helping virus, bacteria, or fungi spread
- Some damage the vine in both ways





# Golden Rules

1. *ALWAYS* clean your equipment before and after it is used
2. *NEVER* let any equipment rest on the ground
3. Use IPM management strategies whenever possible
4. Monitor the vineyard for infections regularly
5. Avoid making large pruning wounds whenever possible

# Golden Rules

6. Time large pruning cuts to avoid rains (late pruning)
7. Remove infected vines and tissue when necessary
8. Time your fungicide applications based on the pathogen's biology
9. Avoid excessive irrigation or fertilization
- 10. Read pesticide labels and talk to an expert if you're stuck!**



Thank You