

Site Selection and Vineyard Design

UCCE North Cost Viticulture

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North Coast

Main Topics

1. Site Selection
2. Site Properties
3. Designing the Vineyard
4. Site Testing
5. Vine Selection and Planting
6. Trellis Design
7. Choosing a Training Style

Site Selection

So, you want to plant a vineyard

You've decided to expand your vineyard by 10 acres

You have 10 acres on both the East and West ends of your property

How would you choose which area is better to plant in?

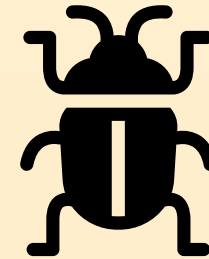


Factors when selecting a site

1. Temperatures
(Maximums and Minimums)



2. Soil properties
(Chemical & Physical)



3. Aspect and Slope

4. Existing pests



5. Water availability

Factors when selecting a site

6. Site History

What was there before?

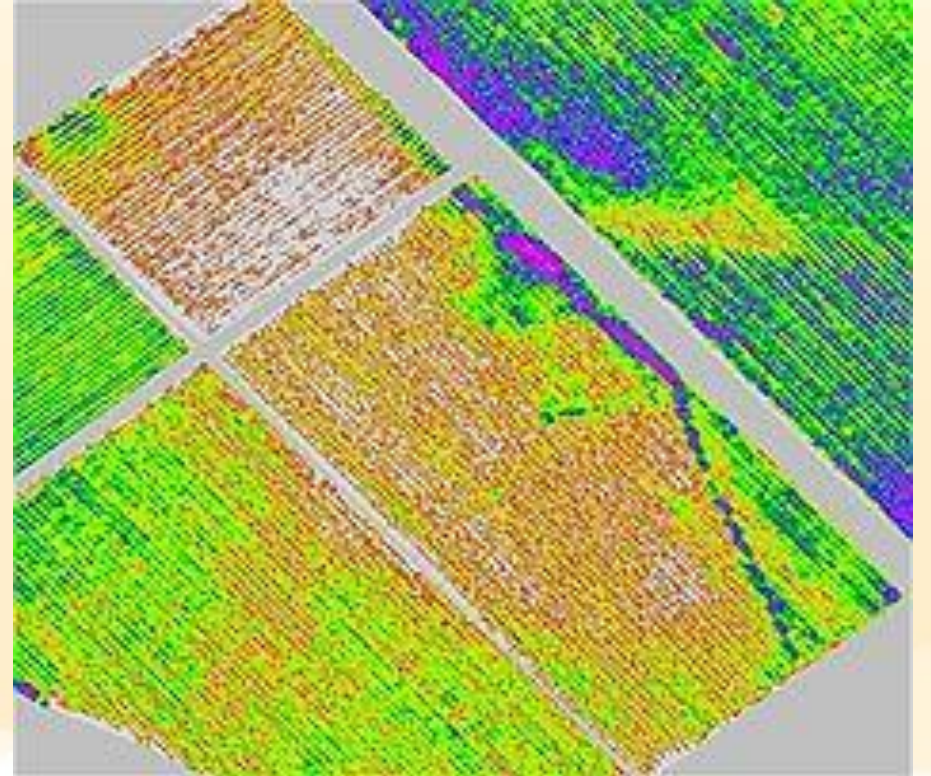
7. Long term plan

8. Weak/Problem areas

9. Laws and Regulations

i.e., VESCO – Sonoma Co.

(Vineyard Erosion and Sediment Control Ordinance)



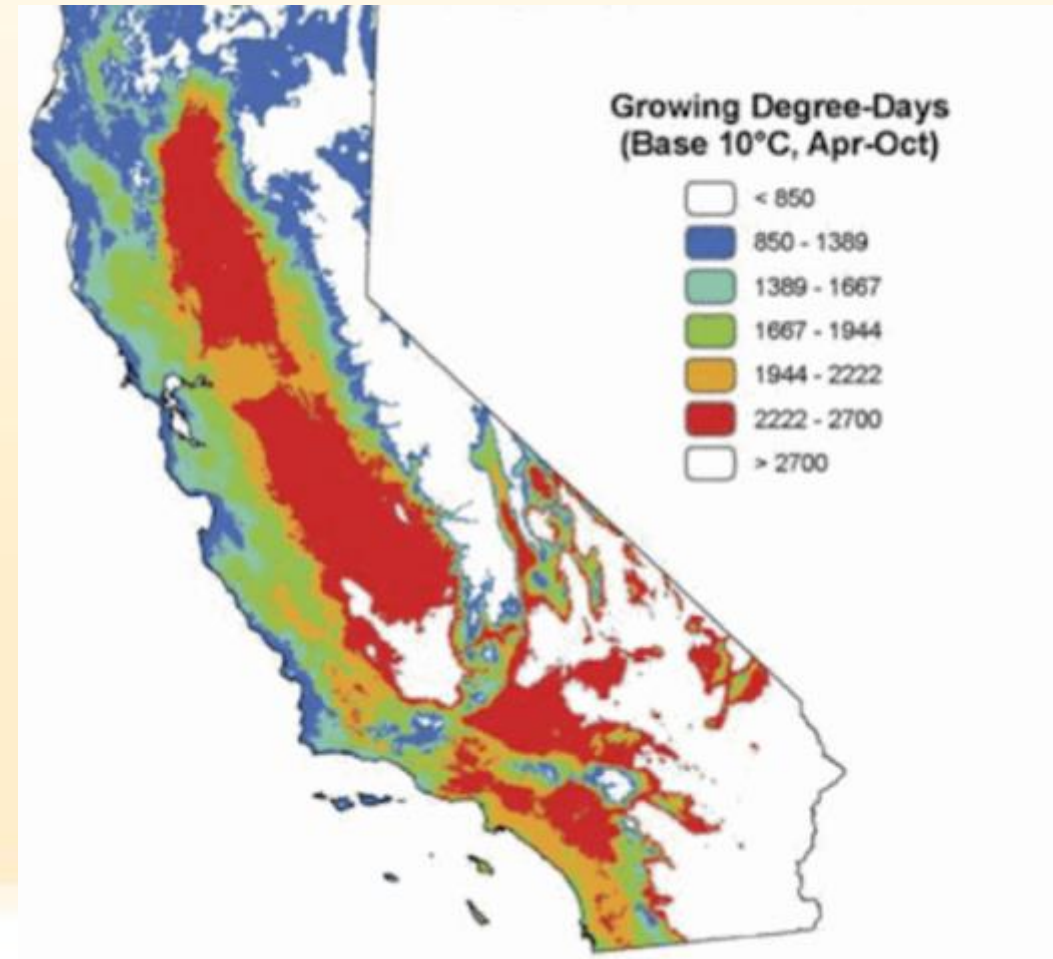
Temperatures

- Grapes like hot summer days and cool summer nights
- Extremes are the most problematic
 - Too hot = sunburn and degradation
 - Too cold = frost damage
- Grapes require a specific length of time both above and below certain temperatures to grow properly



Temperatures

- The impact of heat is measured via accumulated heat-hours or Growing Degree Days (GDDs)
- Grapes can grow in as little as 1500 GDDs (°F) and as much as 5000 + GDDs (°F)
- Napa is considered a region 3-4 on the Winkler Index with Region 1 being coldest



Temperatures

1. Chilling requirement (for dormant buds)

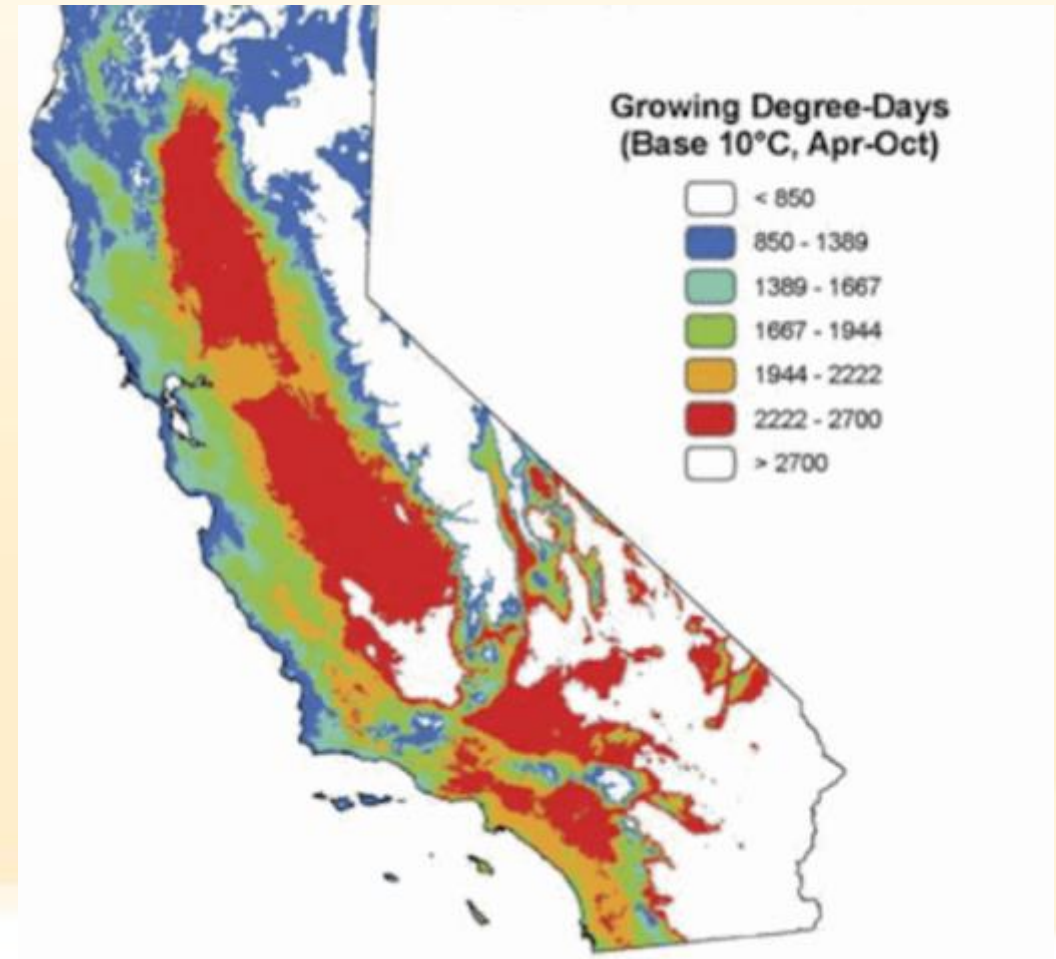
(for dormant buds)

- 600 + hours
- 0 – 7 °C (32-44 °F)

2. Heat Hours (GDDs)

(for shoot growth & fruit development)

- 1500+ hours
- >10 °C (>50 °F)



Temperatures

Different grapes are suitable to different GDDs

We'll go over this later in Vineyard Design

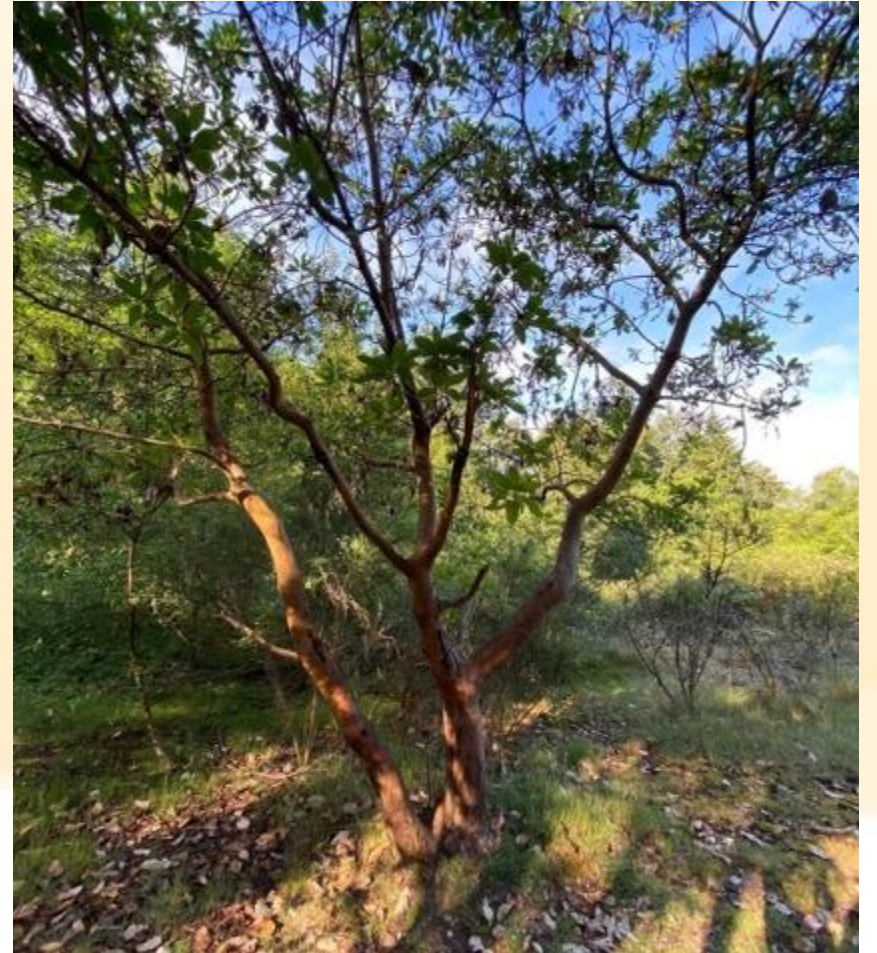
However, the heat accumulation hours at your selected site will impact the vineyard design.



Tips and Tricks – Tree species

Tree species

- Some species of trees are more common where vineyards would perform better
- **Ponderosa Pines**, **Black Oaks**, and **Madrones** often grow in soils that are also good for grapevines



Soil Properties - Physical

- There are some important properties of soil you can measure easily and that will be impactful for the life of the vineyard:
 1. Compaction (Bulk Density)
 2. Water Infiltration rate and holding capacity
 3. Structure/Aggregate Stability
 4. Texture (% sand, silt, clay)
 5. Soil horizons and soil type



Soil Properties - Physical

Compaction (Bulk Density)

- This is an easy test
- Get a baking ring made of steel and a rubber mallet
- Measure the volume of the ring
- Hammer it into the soil and remove the soil in one piece
- Weigh the soil, dry it in your oven, then weigh it again
- This will give you the dry mass/volume
- More compacted soils will have BD values > 1.3 and this can be problematic for root growth

$$BD_{soil} = \frac{\text{Dry mass (grams)}}{\text{Volume (cm}^3\text{)}}$$

Soil Properties - Physical

Water infiltration rate

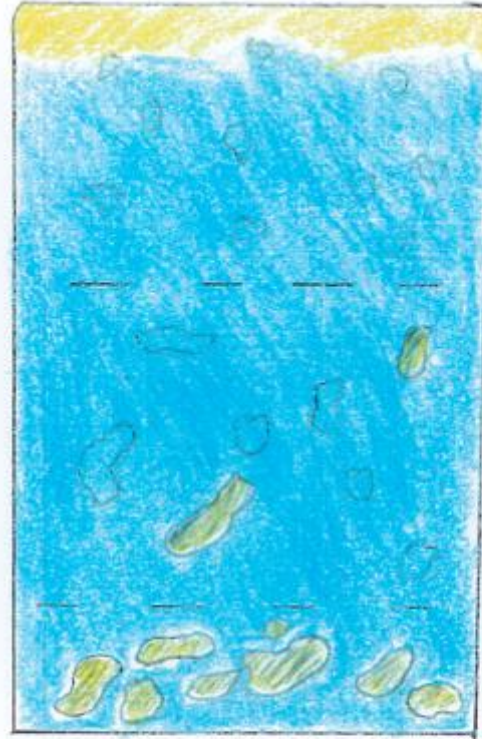
- This is an easy test too
- Use the same baking ring made of steel and a rubber mallet
- Hammer it **halfway** into the soil and cover loosely with plastic wrap
- Measure out 0.5 liters of water
- Pour onto the plastic and slowly remove plastic
- Start a timer
- See how long it takes for the water to be absorbed

$$IR_{soil} = \frac{Volume (cm^3)}{Time (sec)}$$

Saturation



Field Capacity



Permanent Wilting Point







Micropores are dry

Macropores are dry



At **saturation** there is too much water in the system, and it leaches downward with gravity

-  Inundated/Flooded
-  Dry
-  Micropore
-  Macropore

Soil Properties - Physical

Texture

- Fill a mason jar with soil and water
- Shake it and let it settle
- The different particle sizes will settle at different layers
- The percent-of-the-whole by volume of each layer is *roughly* your soil texture
- You can't really fix this so it's important to know before you select a site to plant on



Soil Properties - Physical

Structure/Aggregate Stability

- Fill a bag with soil
- Put a soil sieve with large holes into a bucket of water
- Pour the soil into the sieve and gently rock
- Repeat with smaller sieves until fine dust is all that remains
- This will give you your average soil aggregate size



Soil Properties - Physical

Soil Layers and Soil Type

- Sometimes soils change drastically as you look deeper down
- Dig a soil pit with a backhoe or by hand
- Look at the texture and aggregation in each layer as you go down



Soil Properties - Chemical

1. Nutrient content

- Test all *essential* nutrients
- Divided into Macro and Micronutrients

2. Organic matter content

- Allows for better aggregation
- Helps retain water and nutrients

3. pH

- Ideal pH \approx 5.5 – 6.5



Essential Nutrients

Macronutrients (> 100 ppm)

- Nitrogen (N)
- Phosphorous (P)
- Potassium (K)
- Calcium (Ca)
- Magnesium (Mg)
- Sulfur (S)

Applied in:

- Solid form (pellets)
- Liquid form (fertigation)
- Compost/mulches



Essential Nutrients

Micronutrients (≤ 100 ppm)

- Chlorine (Cl)
- Iron (Fe)
- Boron (B)
- Manganese (Mn)
- Zinc (Zn)
- Copper (Cu)
- Molybdenum (Mo)
- Nickel (Ni)

Typically applied
via foliar sprays



Water availability

Water requirements

- Irrigation Water
 ≈ **0.6 ac-ft/ac** each year
- Overhead frost protection
 ≈ **0.2-0.4 ac-ft/ac** each year

Surface or Groundwater?

Space to build or existing reservoir?



Site History and Existing Pests

Site history can tell you a lot

- What was there before?
 - Hints at potential pests
 - Know what diseases to look for

Survey existing pests

- Know what is there
- What might be a problem



Laws and Regulations

Many regions have Laws and Regulations that limit where a vineyard can be installed or replanted

VESCO (Sonoma County)

Vineyard Erosion and Sediment Control Ordinance

Check laws and regs when deciding where to plant



Designing a Vineyard

Considerations

1. **Cost** – how much does it cost to install a vineyard?

- 2023 ≈ \$40,000 - \$80,000 per acre
- Will it cost more at the site you've selected?
 1. Near a riparian area
 2. Steep slopes
 3. Trellis design
 4. Training type

2. **Geographic Features** – aspect, grade, orientation

3. **Water source** – pumping costs for irrigation & water quality

4. **Neighbors and surrounding vegetation**

Considerations

5. **Climate** – temperature extremes and averages

- When do frost events occur?
- What is the hottest it can get
- What is the dew point or relative humidity?

6. **Wind** – intensity and direction

- Impacts spread of pests
- May help decide on pesticide application methods

7. **Soil types** – what rootstock is best?

- Heavy (high % clay) soils tend to have water issues
- Sandy soils tend to have too much drainage
- Serpentine soils are lacking in nutrients



Considerations

8. **Variety choice** – will it match the site conditions?
 - Some cultivars may perform better
 - Maybe choose based on desired product
9. **Labor availability** – is there enough skilled labor available?
10. **Mechanized or Hand management?**
11. **Trellis design** – impacts training and mechanization
12. **Row x Vine spacing** – high-density or widely spaced?
13. **Existing pests** - what has potential to cause problems?

MANY questions to answer
before planting

Example – let's plant a vineyard

Known features of the site

- 10 acres
- 7' (row) x 5' (vine) spacing
- 1,244 vines/acre
- South-facing slope (2% grade $\approx 1.15^\circ \approx 1:50$)
- 200 ft well – 40 gpm (gallons per minute)
- No frost concerns
- Drip irrigation with 1x 0.5 gph emitter per vine
- Moderately windy
- Soil is a sandy-clay loam (well drained)

Step 1 – Cost Analysis

1. Average price to install a vineyard
 - **\$40,000 - 90,000 / acre**

2. What is the average \$/ton in your region?
 - This changes by variety and AVA
 - i. Pinot noir (Sonoma County) \approx \$3500/ton
 - ii. Cabernet Sauvignon (Sonoma County) \approx \$2700/ton
 - iii. Cabernet Sauvignon (Napa County) \approx \$8000/ton

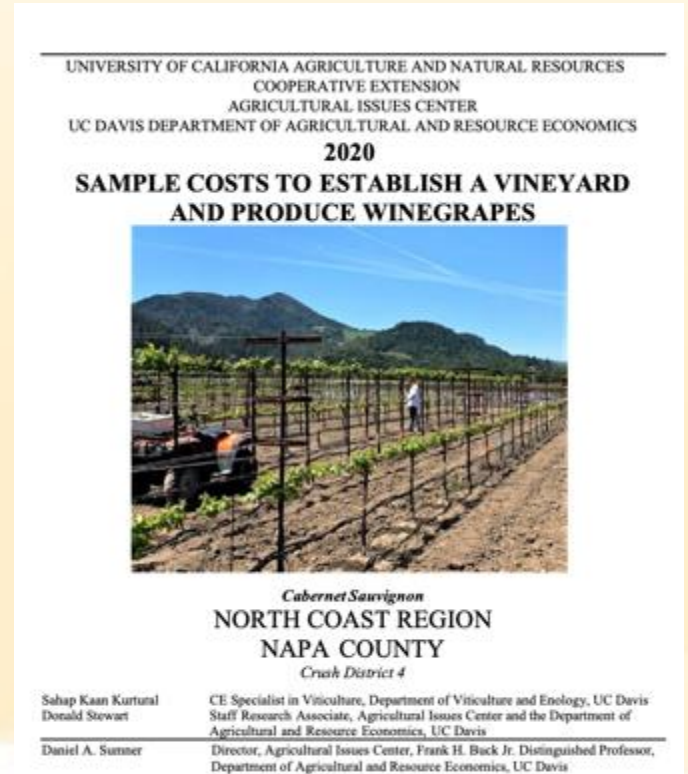
County Average	Price Per Ton					
Napa County						
	2021	Trend	2020	2019	2021 High	2021 Low
Cabernet Sauvignon	\$8,082	+	\$6,260	\$7,941	\$62,825	\$600
Pinot Noir	\$2,637	-	\$2,647	\$2,773	\$9,517	\$1,500
Merlot	\$4,032	+	\$3,217	\$4,055	\$29,527	\$1,200
Zinfandel	\$4,435	+	\$4,007	\$4,339	\$8,350	\$500
Syrah	\$4,251	+	\$3,686	\$4,086	\$8,836	\$1,800
Chardonnay	\$3,245	+	\$3,028	\$3,032	\$12,500	\$1,200
Sauvignon Blanc	\$2,635	+	\$2,453	\$2,485	\$7,250	\$1,000
Sonoma County						
	2021	Trend	2020	2019	2021 High	2021 Low
Cabernet Sauvignon	\$2,728	+	\$2,460	\$3,056	\$21,630	\$800
Pinot Noir	\$3,518	+	\$3,147	\$3,949	\$18,634	\$200
Merlot	\$1,960	+	\$1,590	\$2,000	\$21,482	\$400
Zinfandel	\$3,113	+	\$2,624	\$2,737	\$19,164	\$400
Syrah	\$2,871	+	\$2,472	\$2,812	\$8,468	\$100
Chardonnay	\$2,284	-	\$2,311	\$2,414	\$15,000	\$450
Sauvignon Blanc	\$1,730	+	\$1,554	\$1,814	\$5,719	\$800

Step 1 – Cost Analysis

3. What is your target tons/acre?
 - Boutique (high price ~ low yields)
 - Bulk (low price ~ higher yields)

4. What will the costs be for installation and management?
 - Installation ≈ \$7,500/acre/year
 - Management ≈ \$10,000/acre/year

5. How long until you make profit?



Step 2 - Site preparation and layout

1. Level the land to encourage drainage
2. Decide which direction you want to have your rows
 - NE-SW is often best in California to get even sun exposure
3. Decide the spacing for the rows and vines
 - High-density = 7ft (row) x 5ft (vine)
 - 1,244 vines per acre



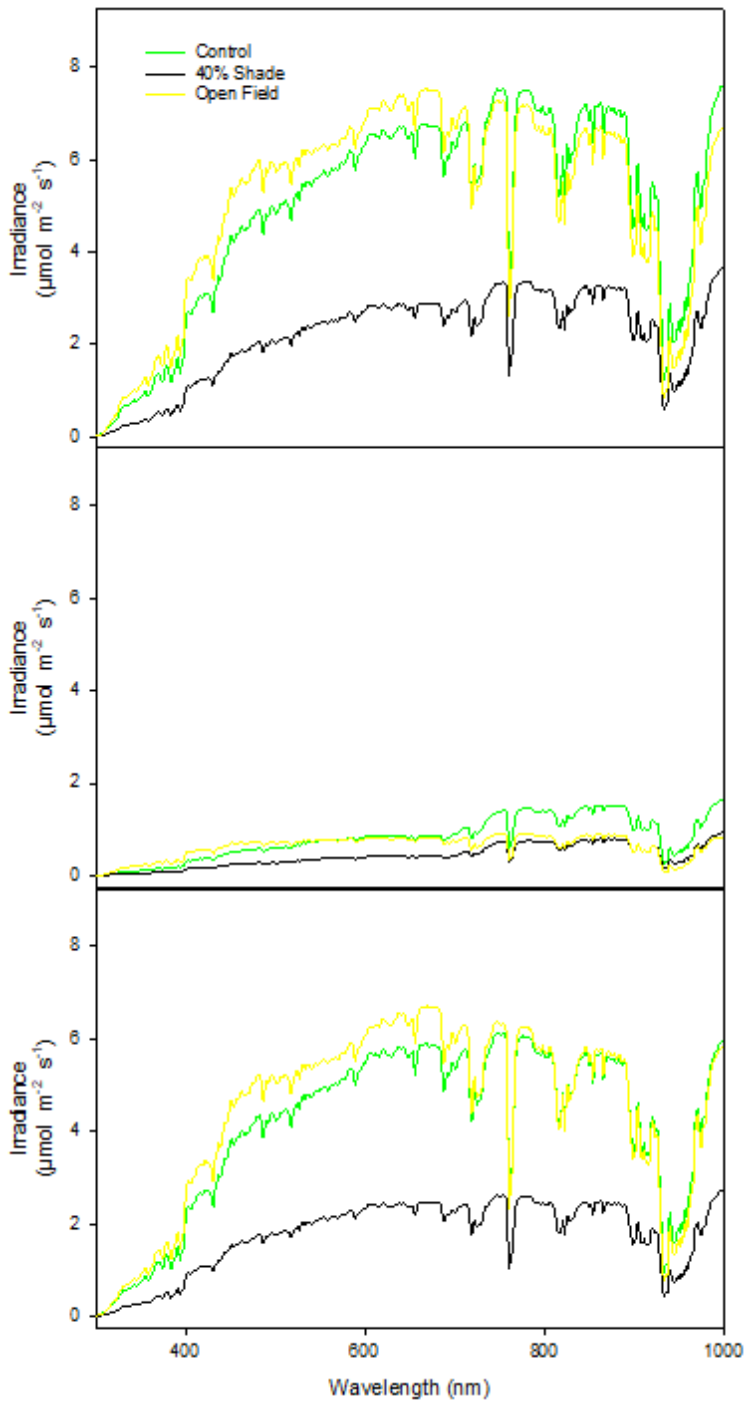


Row Spacing

Row spacing can impact the effects of shading from adjacent rows

Too far apart (e.g., image to left) and the vines will not shade out their neighboring rows

Too close together, and the berries may not get enough solar radiation to ripen at a reasonable pace.



Fruit Zone Light Conditions

Light conditions in the fruiting zone (i.e., where the clusters hang) can be drastically different from ambient conditions

Here, vines shaded with black shade netting have an irradiance level $< \frac{1}{2}$ that of the open field next to it.

Step 2 - Site preparation and layout

4. Add nutrients and amendments based on soil testing
5. Rip (3-way) and disc soil to prepare for planting



Soil Preparation

Before planting a vineyard, it is important to prepare the soil

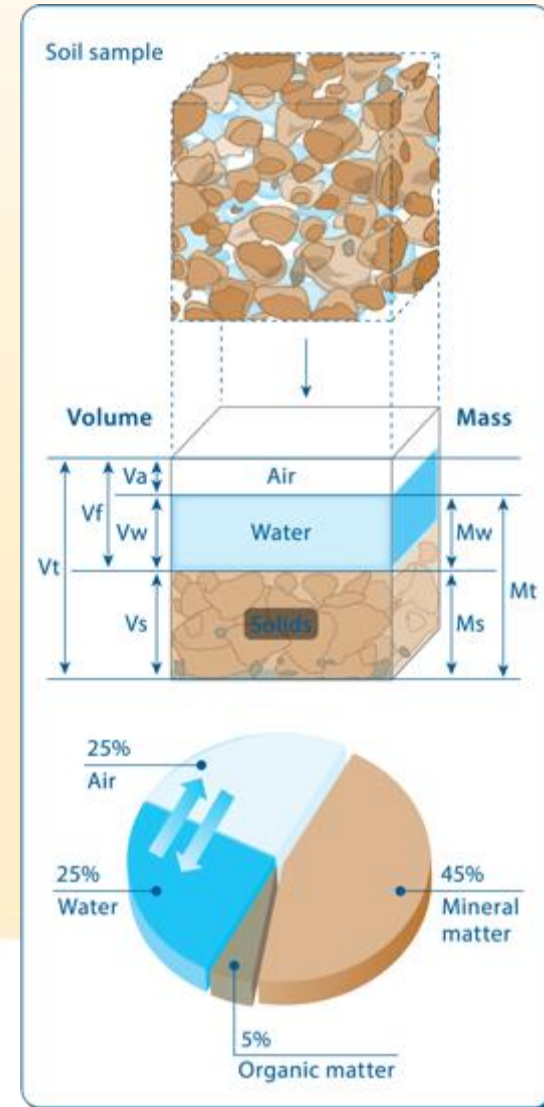
The average lifespan of a vineyard is 25-35 years

Proper soil preparation is key to long-lived grapevines



Goals of Soil Preparation

1. Maintain or improve soil structure
 - Soil aggregate stability
 - Macropores and micropores
2. Retain water physical characteristics
 - Infiltration, WHC, and field capacity
3. Improving availability of essential plant nutrients
 - Compost and mulch amendments
 - Modifying soil pH
4. Avoid soil compaction for better root proliferation
 - Limit soil compaction



Key Concepts - Soil Preparation

- 1. Test your soils** for mineral and nutrient content first
 - Testing your soil can inform you of any problems that might arise
 - Testing the pH of the soil can also inform you of the availability of certain nutrients
- 2. Avoid wet days**
 - Any soil prep done during periods where the soil is wet will increase the compaction on site



Testing Soils – How to Sample

Soil testing can tell you a lot about your site.

There are some basic guidelines to follow when taking soil samples

○ x x x	x x x x
x x x ○	x x x x
x x x x	x x x ○
x x x x	○ x x x
○ x x x	x x x x
x x x x	x ○ x x
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x x ○ x	x x x x
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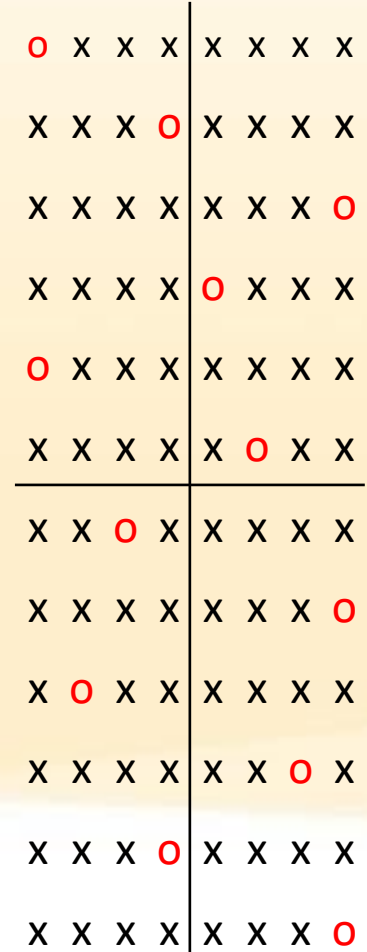
Testing Soils – How to Sample

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1. Take your samples on a grid
 - i. Dividing your vineyard into equal sections
 - ii. Selecting the same number of sample sites in each helps get an overall picture of the soil.

Divided into a grid pattern



Same number of samples in each quarter

Testing Soils – How to Sample

Soil testing can tell you a lot about your site.

There are some basic guidelines to follow when taking soil samples

1. Take your samples on a grid
 - i. Dividing your vineyard into quarters
 - ii. Selecting the same number of sample sites in each helps get an overall picture of the soil.
2. Randomly select your sampling sites
 - i. This helps reduce bias in your sampling
 - ii. Select sites on a map, not in the field

Sampling points (○) selected randomly from quarters

○ x x x	x x x x
x x x ○	x x x x
x x x x	x x x ○
x x x x	○ x x x
○ x x x	x x x x
x x x x	x ○ x x
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x x ○ x	x x x x
x x x x	x x x ○
x ○ x x	x x x x
x x x x	x x ○ x
x x x ○	x x x x
x x x x	x x x ○

Testing Soils – How to Sample

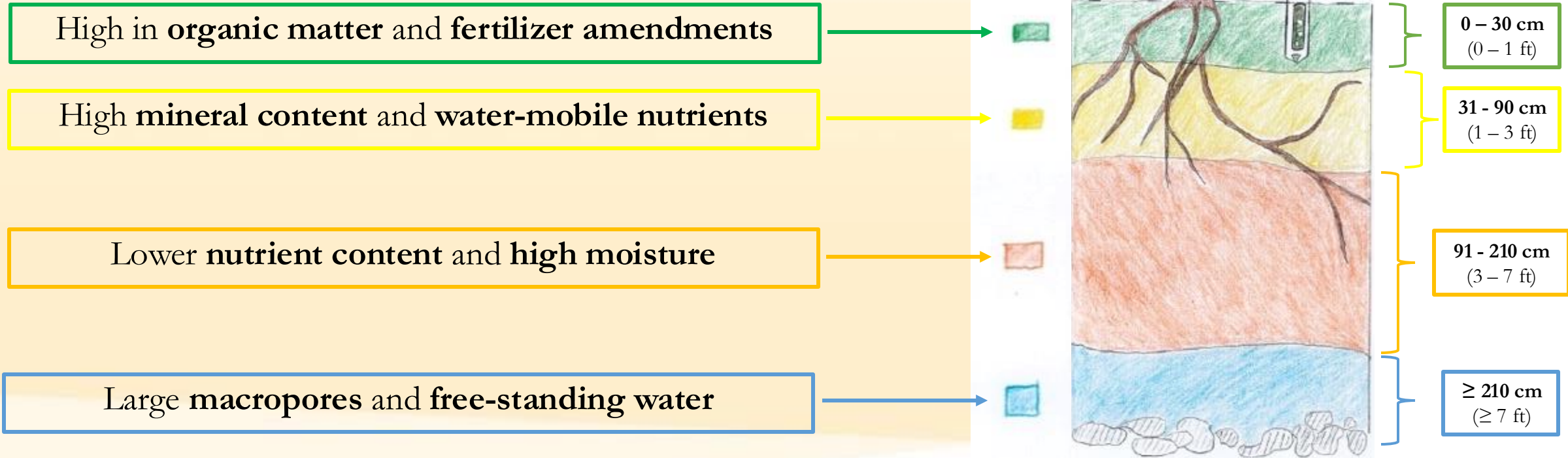
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 - i. Dividing your vineyard into quarters and selecting the same number of sample sites in each helps get an overall picture of the soil.
2. Randomly select your sampling sites
 - i. This helps reduce bias in your sampling
 - ii. Select sites on a map, not in the field
3. Take samples at multiple depths
 - i. 0-1 ft ; 1-2 ft ; 2-3 ft



Testing Soils – Sample Depth



Testing Soils – Water Holding Capacity (WHC)

How much water a soil can hold is important for vine growth

Measuring WHC requires that the soil is at **Field Capacity**.

Soil-Water Scenarios:

1. **Saturation** – All air pockets (pores) are filled with water
2. **Field Capacity** – Only Micropores are filled with water
3. **Permanent Wilting Point** – No pores are filled with water

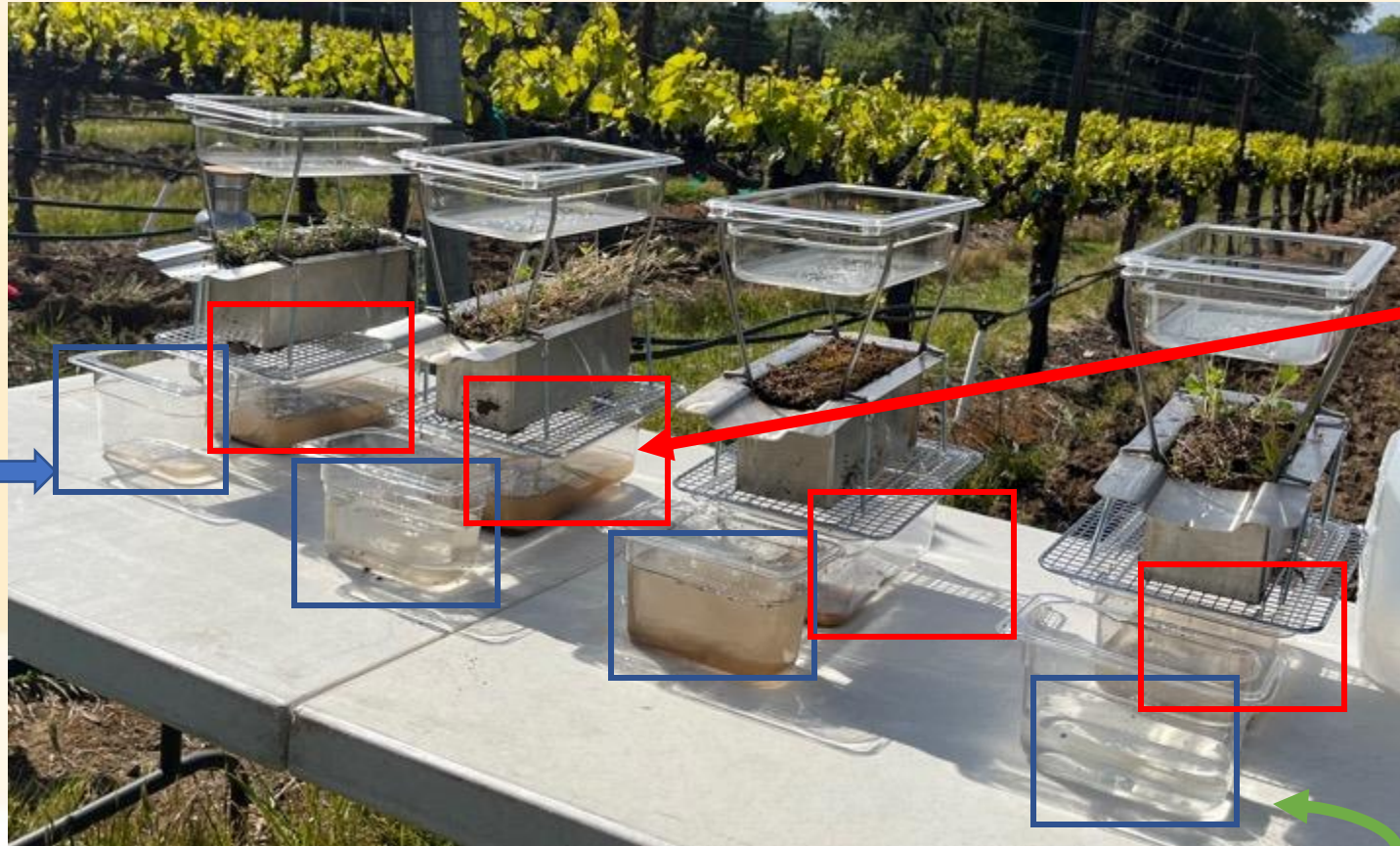
Testing Soils – Water Infiltration Rate

How much water can get into the soil profile and how quickly?

Improving Infiltration Rate:

1. **Cover Crops** – Increase soil aggregation and infiltration
2. **Till/Disc**– Break up compacted areas
 - (highly compacted vineyard soils)
3. **No Till**– Prevents aggregates from being broken
 - (already well-established soils)

Testing Soils – Water Infiltration Rate

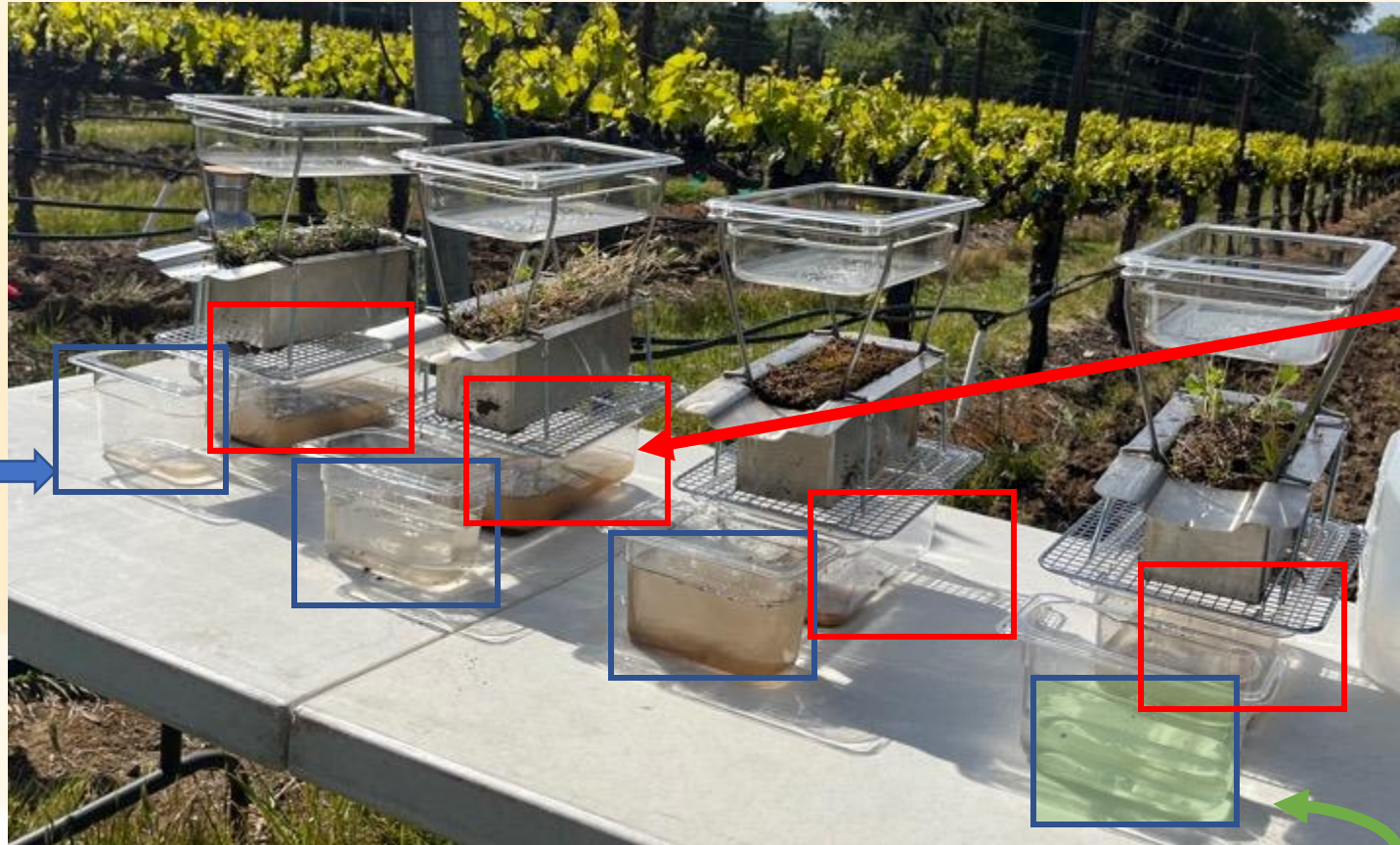


How much water can get into the soil and can move down the soil profile?

How much water runs-off of the soil without infiltrating

How clean is the runoff water?

Testing Soils – Water Infiltration Rate



How much water runs-off of the soil without infiltrating

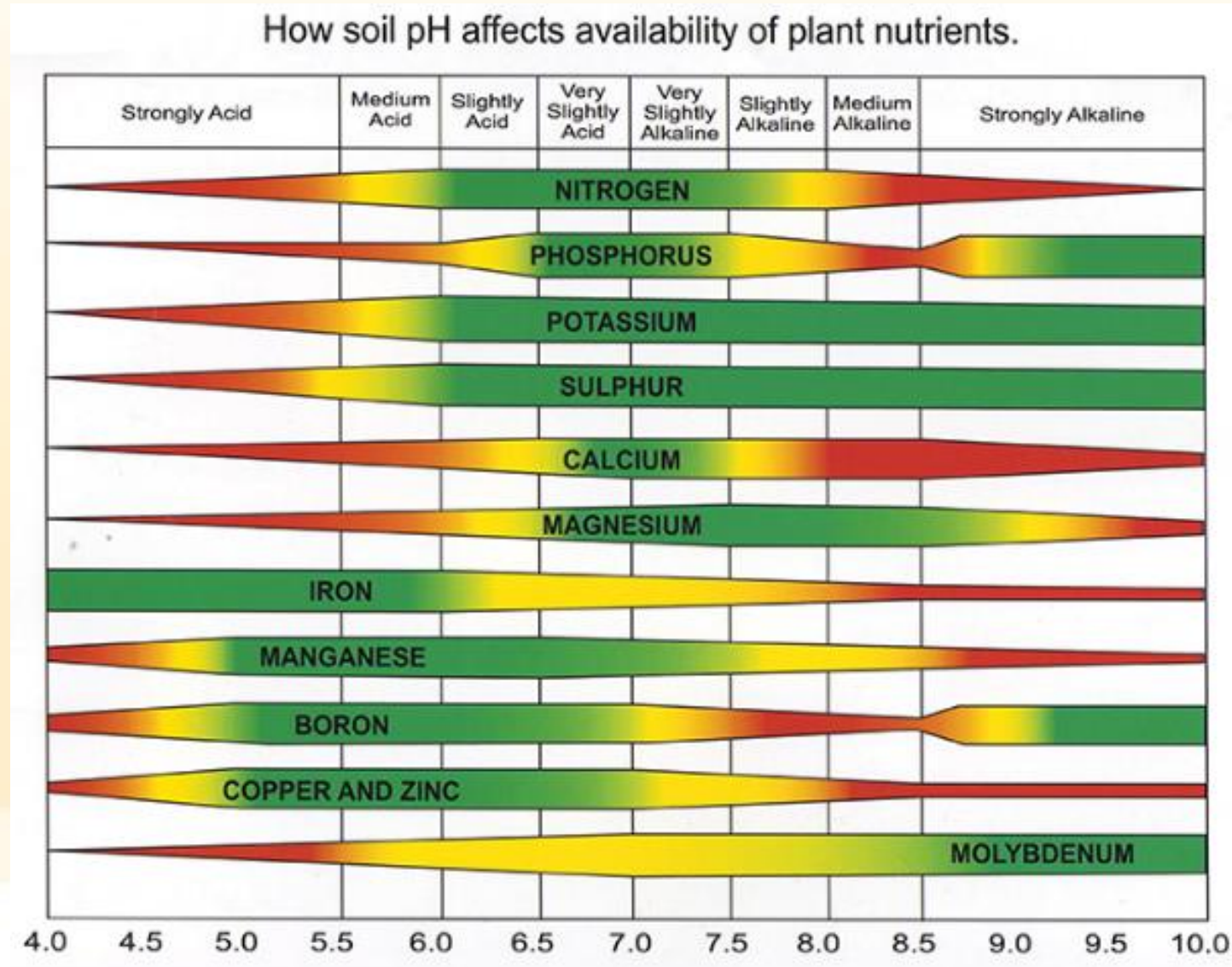
How much water can get into the soil and can move down the soil profile?

How clean is the runoff water?

Testing Soils – pH

Soil pH can tell you a lot about a site:

1. What nutrients are plant-available.
2. How fertilizers will interact with the soils.
3. The suitability of the site for grapevines



Testing Soils – pH

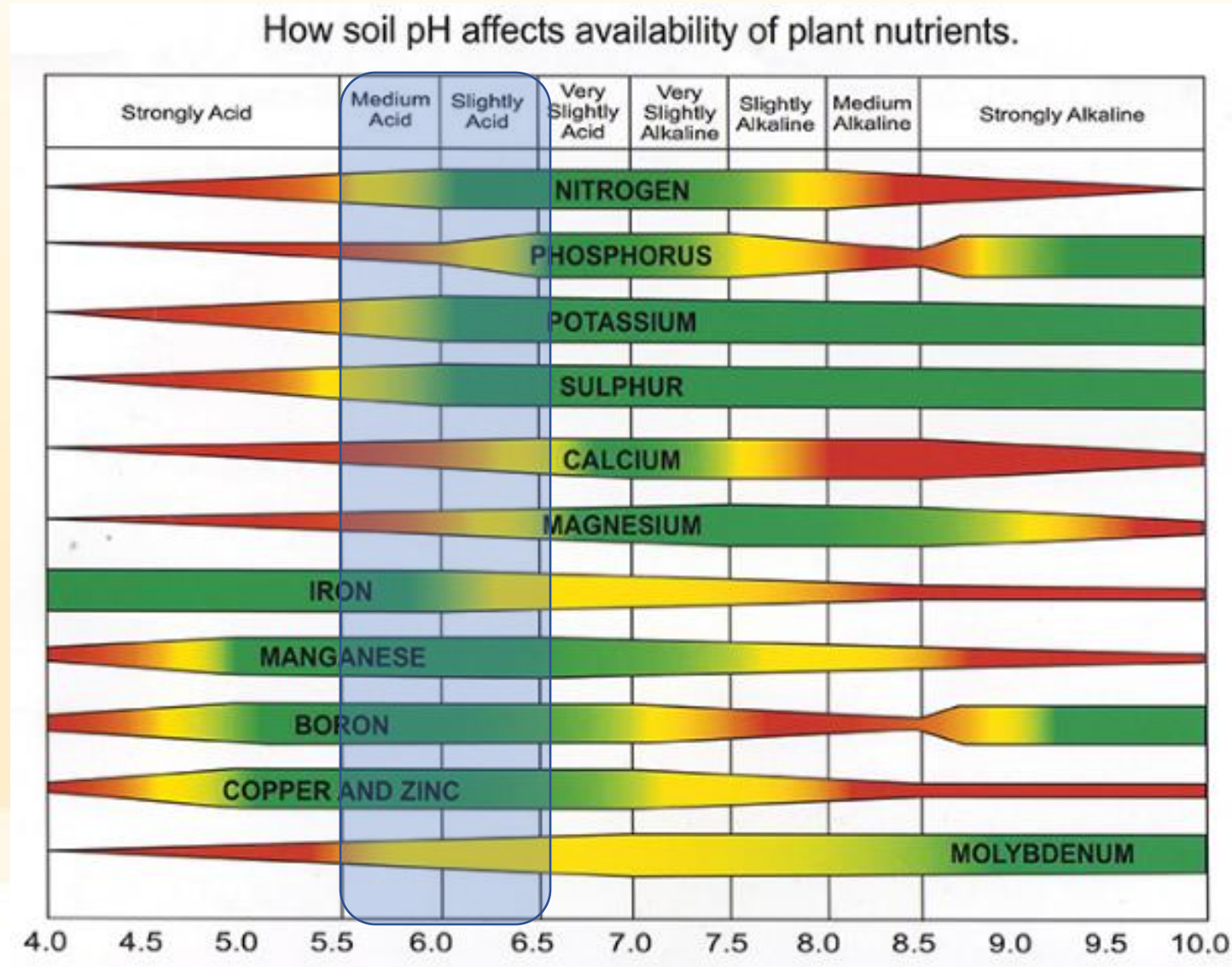
5.5 - 6.5

Ideal range for vineyard soil pH

Closer to 5.5 = Rootstocks

Closer to 6.5 = *V. vinifera*

All essential plant nutrients are readily available within this range



Testing Soils – Nutrient content

Soil nutrient content are valuable data for planning:

1. What nutrients are deficient, sufficient, or in excess.
2. What nutrients need to be replaced before vines start growing.
3. What to expect from a site (e.g., Boron toxicity).

Essential Elements for Plant Growth	
Macronutrients	Micronutrients
Carbon (C)	Iron (Fe)
Hydrogen (H)	Manganese (Mn)
Oxygen (O)	Boron (B)
Nitrogen (N)	Molybdenum (Mo)
Phosphorus (P)	Copper (Cu)
Potassium (K)	Zinc (Zn)
Calcium (Ca)	Chlorine (Cl)
Magnesium (Mg)	Nickel (Ni)
Sulfur (S)	Cobalt (Co)
	Sodium (S)
	Silicon (Si)

Testing Soils – Nutrient content

1. Soil nutrient content can be tested by a plant and soils analysis laboratory:

[Selected Plant and Soil Labs of CA](#)

2. It may also be important to compare your soil nutrient content with vine nutrients later in the season.
3. Soil nutrients should be repeated every few years to identify and address potential problems with vine nutrition.

Essential Elements for Plant Growth	
Macronutrients	Micronutrients
Carbon (C)	Iron (Fe)
Hydrogen (H)	Manganese (Mn)
Oxygen (O)	Boron (B)
Nitrogen (N)	Molybdenum (Mo)
Phosphorus (P)	Copper (Cu)
Potassium (K)	Zinc (Zn)
Calcium (Ca)	Chlorine (Cl)
Magnesium (Mg)	Nickel (Ni)
Sulfur (S)	Cobalt (Co)
	Sodium (S)
	Silicon (Si)



Testing Soils – Pests and Diseases

Soils are the habitat of many pests that may spread vine diseases or damage roots:

1. Phylloxera
2. Dagger Nematode
3. Root-Knot Nematode
4. Ring Nematode
5. Ground Rodents
6. Mealybug
7. Borers

Testing Soils – Pests and Diseases

Understanding what is already in the soil requires site history and surveys:

1. If the location was planted to grapevines before it is more likely grape-specialized pests and diseases are already present.
 - i. e.g., Nematodes and Phylloxera
2. If you don't have any idea what might be there, contact your local PCA (Pest Control Advisor)



Soil Preparations – Removing Inoculum

If your future vineyard was previously planted to grapevines, it's important to **remove any and all roots from the previous vines.**

These can serve as a refuge for:

1. Viruses (e.g., *Red blotch*)
2. Bacteria (e.g., *Xylella fastidiosa*)
3. Fungi (e.g., Overwintering bodies)
4. Nematodes and Phylloxera



Example of persistent fungal infections in leftover roots of removed vines

Step 3 – Vine selection and planting

1. Choose your rootstock and scion combinations
 - This should have been done 1.5 years before planting (nursery order)
 - These should be chosen based on your soil, climate, and desired end product
2. Select your trellis system
 - VSP or T-top
3. Install end-posts, dripline, and t-posts for each row



Step 3 – Vine selection and planting

4. Prepare the soils
 - apply amendments and pesticides
5. Plant vines
 - Dig a hole 30% larger than you think you need when planting
 - Trim roots to avoid J-rooting or root-girdling
 - Irrigate immediately if green growers
6. Winterize
 - If necessary, winterize your vineyard to prevent rain-induced erosion



Side Quest – Choosing a rootstock and scion

1. Purpose
 - High yields or High 'quality'?
2. Site fertility
 - Good/healthy soils = less vigorous rootstock
 - Poor soils = more vigorous rootstock
 - High vigor scion (i.e., Sauvignon blanc) = low vigor rootstock
3. Soil properties
 - Drought prone = deep rooting rootstock (110R/1103P)
 - Sandy soils = nematode resistant rootstock (039-16/GRN series)
 - Waterlogged = rootstock with high water requirement (3309C/101-14)
4. Scion selection
 - Choose rootstock based on what cultivar scion you select

Cultivars by Climate

Variety	Region	Climate	Vigor	Yields
Chardonnay	I, II	Cold	Moderate	Moderate
Sauvignon blanc	I, II, III	Cool	High	High
Riesling	I, II, III	Cool	Moderate	Moderate
Gewürztraminer	I, II	Cool	Moderate	Low
Sémillon	II, III	Warm Coasts	Moderate	High (clonal 8-10)
Melon	I, II	Cold	Moderate	Moderate
Pinot blanc/gris	I, II	Cool	Low	Low-Moderate
Viognier	III, IV	Warm-Hot	Moderate	Low
Colombard	II, III, IV	Warm	High	High
Chenin blanc	II, III	Cool-Warm	High	High
Emerald Riesling	II, III	Cool-Warm	High	High
Burger/Monbadon	III, IV, V	Warm-Hot	High	High
Palomino/Listan	IV, V	Hot	High	High
Muscat blanc	II, III, IV	Warm	Low-Moderate	Low-Moderate
Malvasia bianca	II, III, IV	Warm	Moderate	Moderate
Cabernet sauvignon	I, II, III	Cool	High	Moderate

Rootstocks by Usage

Rootstock	Vitis parentage	Phylloxera resistance	Nematode Resistance		Tolerance				Influence on scion		Soil adaptation	Ease of propagation	Other characteristics
			Root knot	Dagger (<i>Xiphinema index</i>)	Drought	Wet soil	Salinity	Lime	Vigor	Mineral nutrition ¹			
Riparia Gloire	riparia	High	Low	Med.	Low	Low	Med.	Low	Low–med.	N, P: low K, Mg: low–med.	Deep, well-drained, fertile, moist soils	High	Early maturation; scions tend to overbear
St. George (<i>Rupestris du lot</i>)	rupestris	High	Low	Low	Low–med. in shallow soils; high in deep soils	Low–med.	Med.–high	Med.	High	N: high P: low on low-P soils, high on high-P soils K: high	Deep soils	High	Fruit set problems with some scions; latent virus tolerant
SO4 (Selection Oppenheim)	berlandieri × riparia	High	Med.–high	Low–med.	Low–med.	Med.–high	Low–med.	Med.	Low–med.	N: low–med. P: med. K: med.–high Mg: med.	Moist, clay soils	Med.	Noted as a cool-region rootstock
5BB (Kober)	berlandieri × riparia	High	Med.–high	Med.	Med.	Low	Med.	Med.–high	Med.	N: med.–high P, K, Zn: med. Ca, Mg: med.–high	Moist, clay soils	High	Susceptible to phytophthora root rot; adapted to high-vigor varieties
5C (Teleki)	berlandieri × riparia	High	Med.–high	Low–med.	Low	Low–med.	Med.	Med.	Low–med.	N: low P, K: med. Mg: med.–high Zn: low–med.	Moist, clay soils	High	—
420A (Millardet et de Grasset)	berlandieri × riparia	High	Med.	Low	Med.	Low–med.	Low	Med.–high	Low	N, P, K: low Mg: med. Zn: low–med.	Fine-textured, fertile soils	Med.	Scions tend to overbear when young
99R (Richter)	berlandieri × rupestris	High	Med.–high	Low–med.	Med.–high	Low	Med.	Med.	Med.–high	P: med. K: high Mg: med.	Tolerant of acid soil	Med.	Young scions may develop slowly
110R (Richter)	berlandieri × rupestris	High	Low–med.	Low	High	Low–med.	Med.	Med.	Med.	N: med. P: high K: low–med. Mg, Zn: med.	Hillside soils; acid soils	Low–med.	Develops slowly in wet soils

140 Ru



140 Ru – deep rooted

101-14 mgt



101-14 mgt – shallow rooted

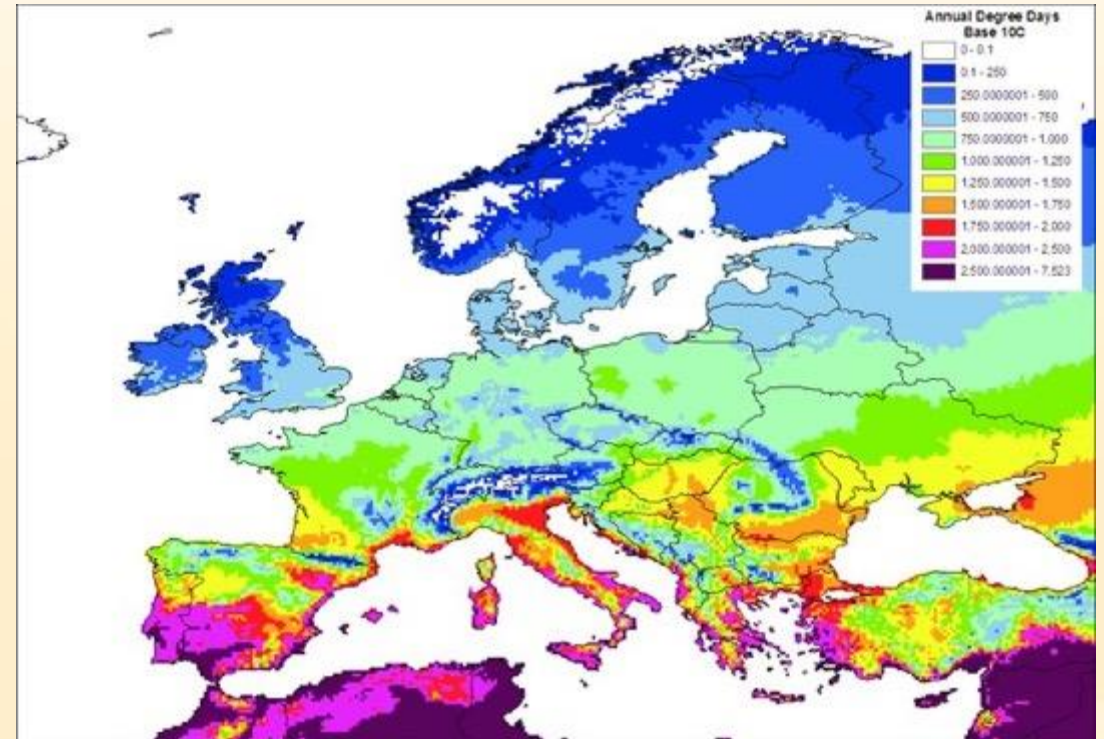
Climatic Origins

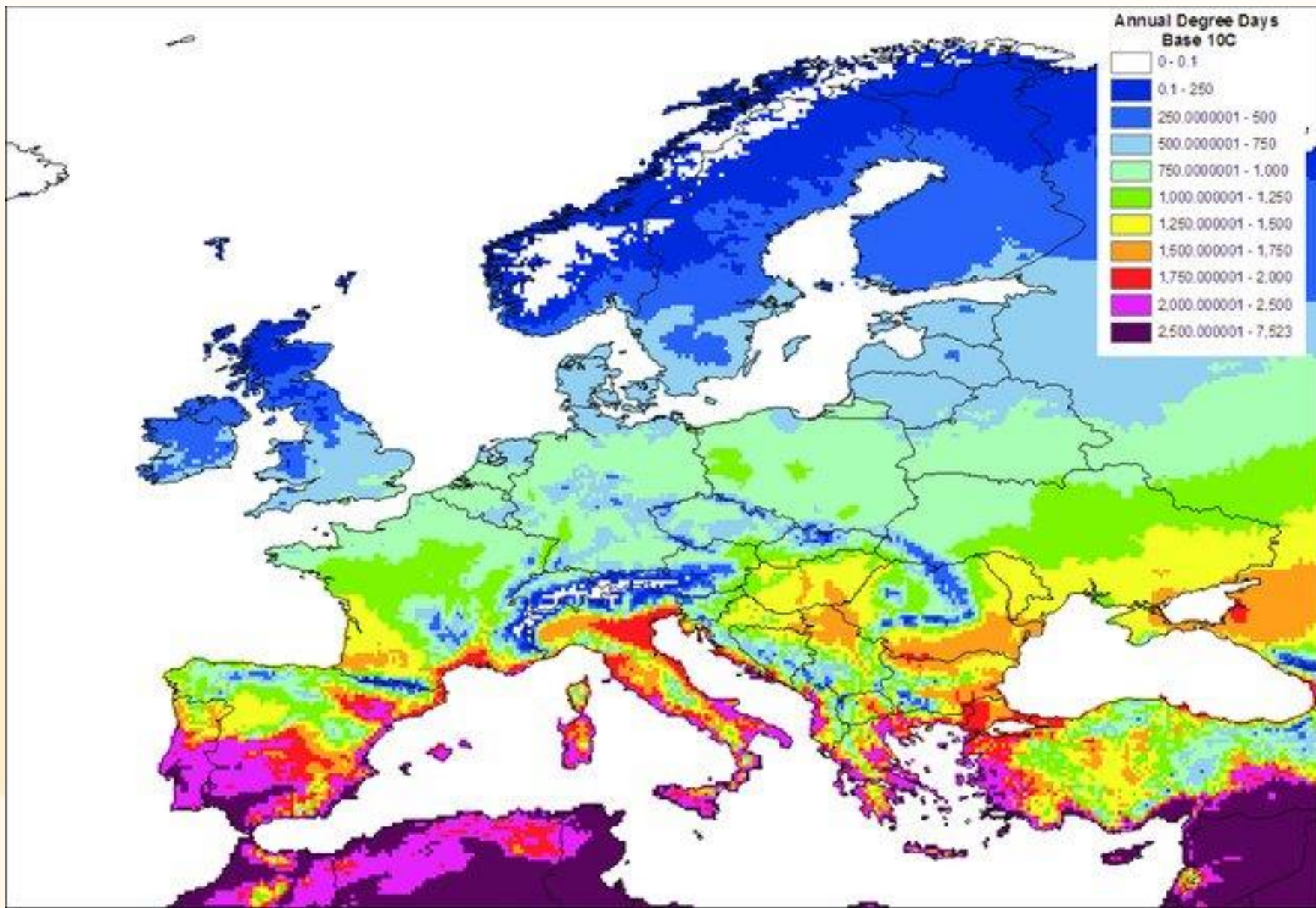
Where did the scions originate from?

This impacts their tolerance for heat (and other stressors)

- Rootstocks \neq Phylloxera
- Vinifera roots = Phylloxera

Think about how your climate matches up with the original climate of the scion





Side Quest – Trellis selection

1. How vigorous do you expect your vines to be?
 - Need to match the trellising with vigor
 - Needs to support the whole vine
2. Wind considerations
 - Canopy = Sail (smaller, shorter trellis for windy sites)
3. Mechanization or hand management
 - VSP and T-top better for mechanization
4. Solar radiation distribution
 - Need enough exposure to ripen
 - Not so much that fruit burns



Goals when training grapevines to a trellis

1. Increase **leaf area** available for photosynthesis
2. Improve bud fruitfulness by **increasing sun exposure to developing buds**
3. Improve fruit quality by **increasing sun exposure**
4. Better **distribute the fruit** over the vine area





Goals when training grapevines

5. Limit fungal diseases by reducing canopy density and **increasing air movement**
6. Improve the conditions for **better distribution of pesticides**
7. Facilitate **mechanization** in the vineyard





Considerations when selecting a trellis type

1. Capacity
2. Viticultural goals
3. Fruiting zone
4. Row & vine spacing
5. Cultivar/rootstock
6. Economics
7. Mechanization



Trellising Decisions

1. Vigor of site - soil depth, texture, water- holding capacity
 - "Large" systems for vigorous sites (e.g., quadrilateral Lyre trellis)
 - "Small" systems for weaker sites (e.g., bilateral T-top trellis)
2. Aspect of the site – which way is it facing
 - Southern and Western facing often warmer (receive afternoon light)
 - Avoid too much sun exposure while maintaining enough to ripen fruit
3. Wind – want a smaller, more open canopy if very windy
 - Large canopies in windy locations can fall over and take out a whole row
4. Mechanization – do you want your management to be heavily mechanized?
 - If so, pick a trellis that's designed for this (e.g., VSP)

Common Types of Vineyard Trellising

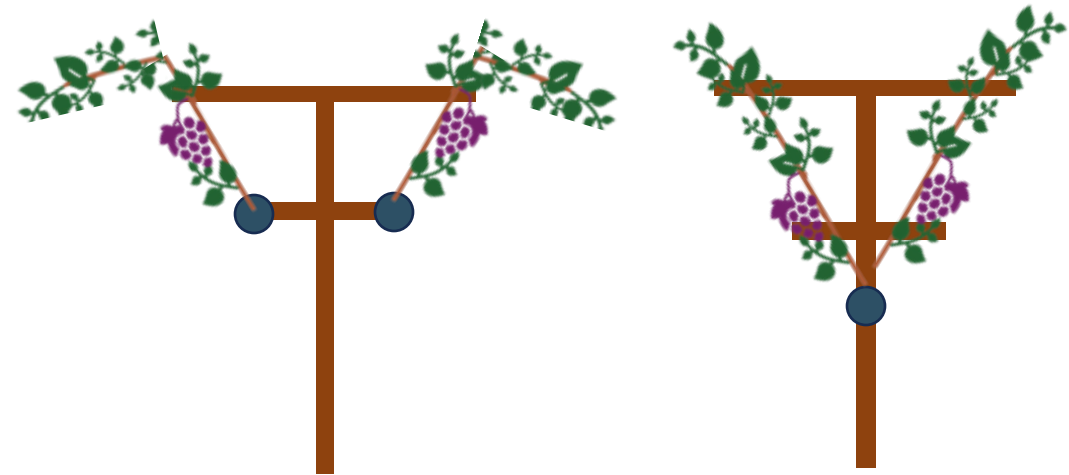
Can be divided into two main categories

Single Canopy

- One wire for cordons or fruiting canes
- One or two cordons per vine

Split Canopy

- Two wires for cordons or fruiting canes
- Three or four cordons per vine



Split-Canopy
(summer)

Single-Canopy
(summer)

- Trellis Structure
- Optional Addition
- Cordon

Common Types of Vineyard Trellising

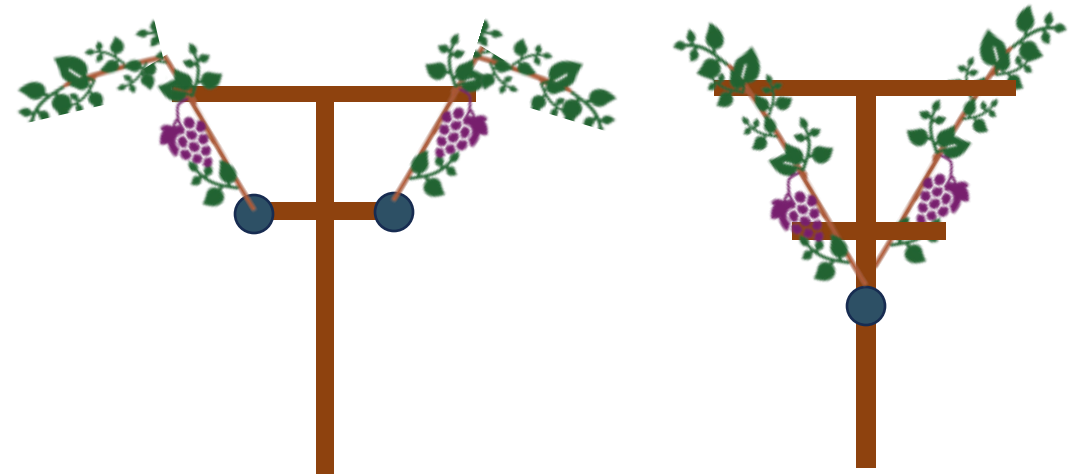
Can be divided into two main categories

Single Canopy

- One wire for cordons or fruiting canes
- One or two cordons per vine

Split Canopy

- Two wires for cordons or fruiting canes
- Three or four cordons per vine



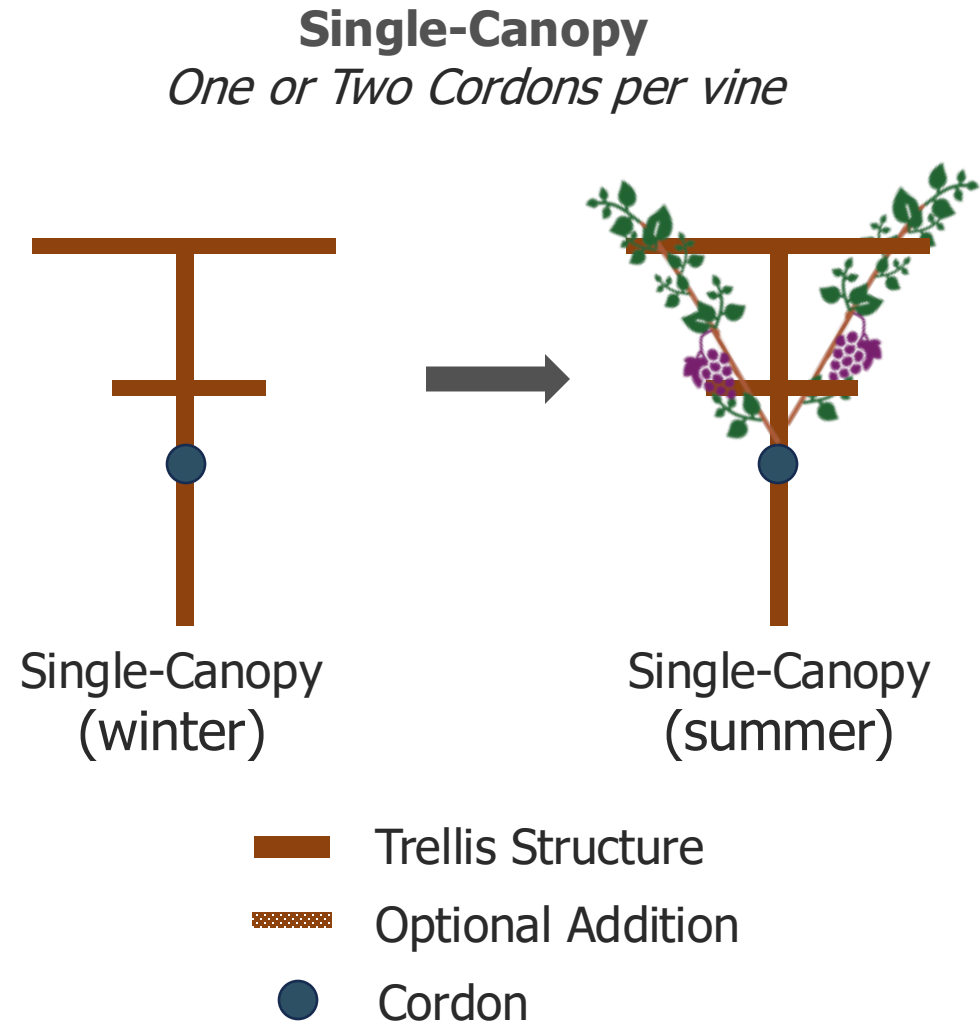
Split-Canopy
(summer)

Single-Canopy
(summer)

- Trellis Structure
- ▨ Optional Addition
- Cordon

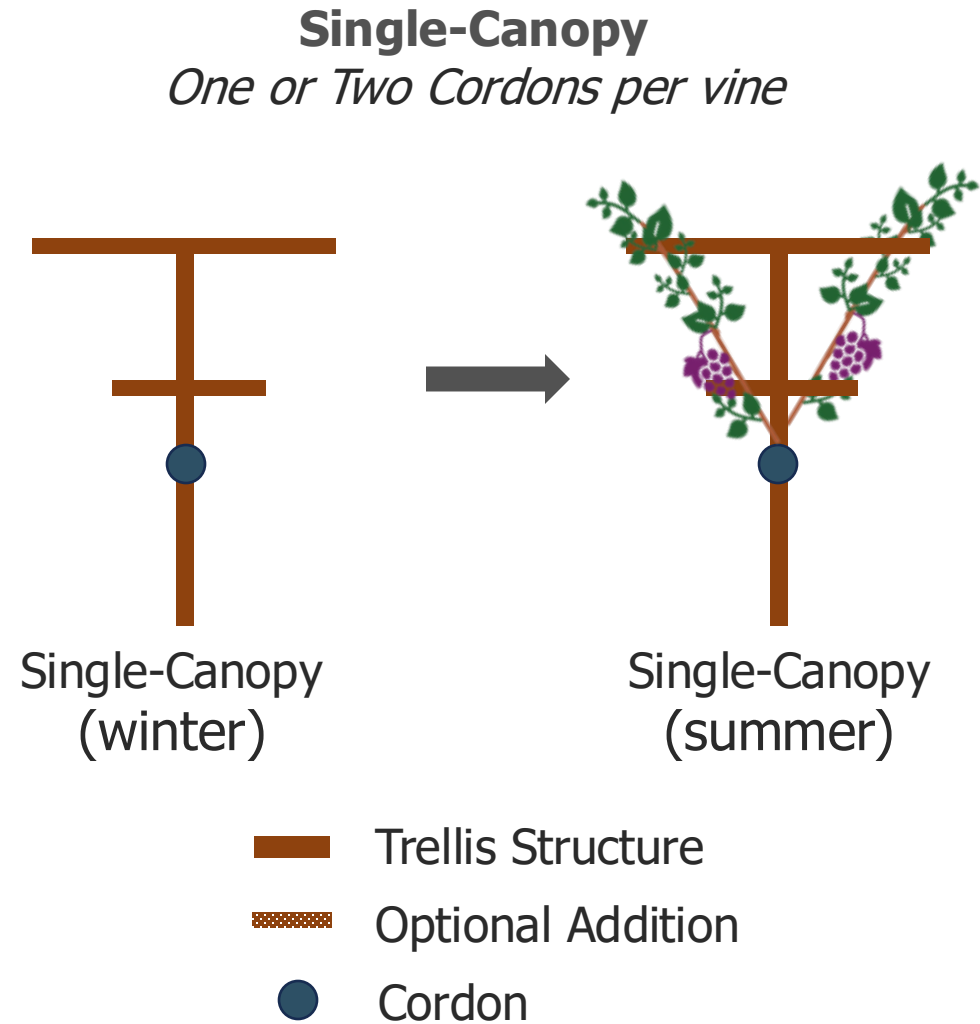
Single Canopy Systems

- Single Canopy trellis systems are divided at the trunk only once
- Only one plane of shoots (like a wall)
- This makes them unilateral or bilateral
- May be cane or cordon trained



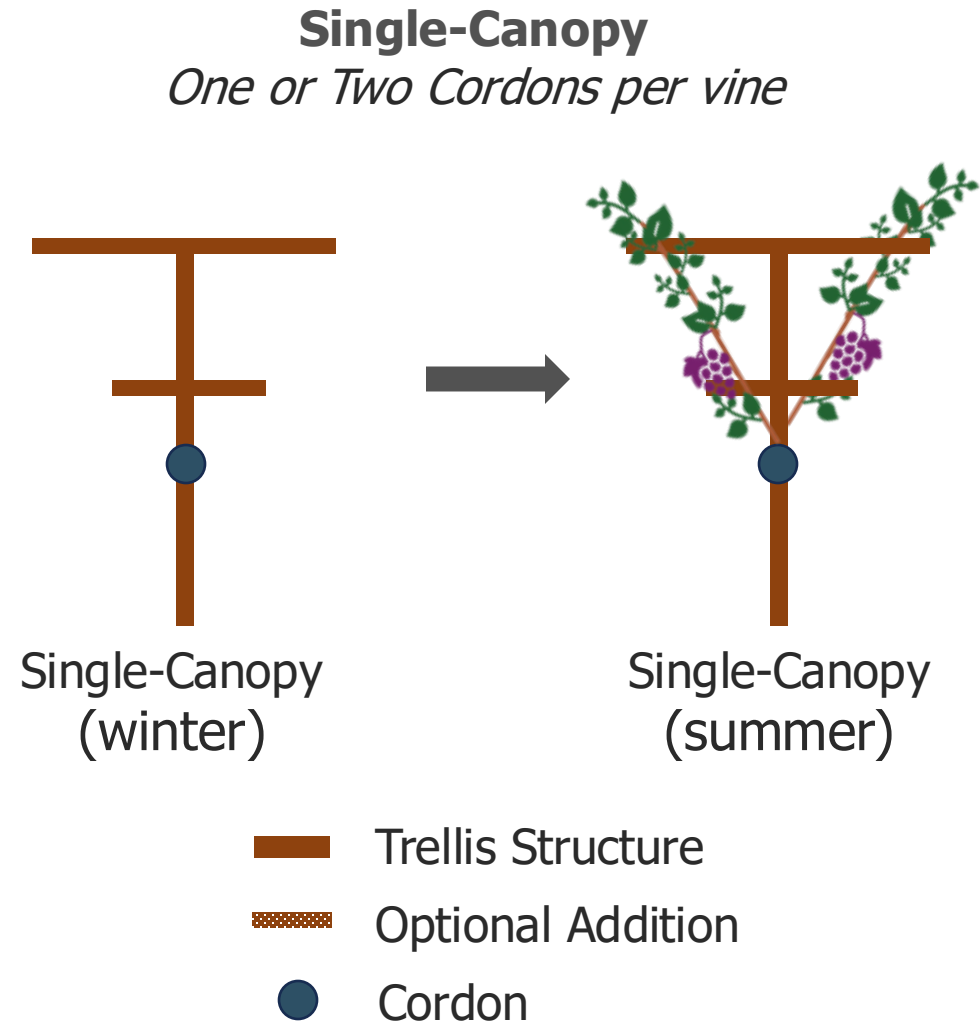
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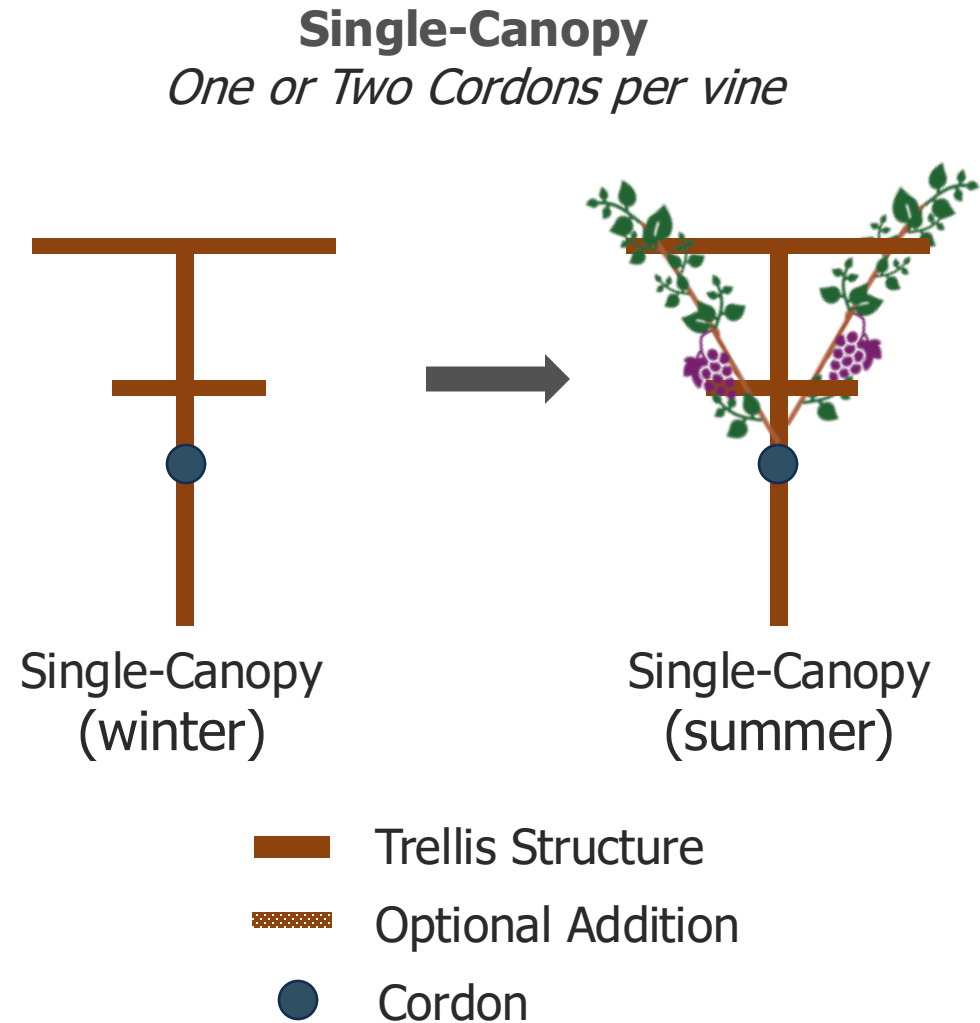
Benefits and Detriments of Single Canopy Systems

- Help to maintain smaller vines that may support fewer buds than vigorous vines
- Fewer growing points = less fruit/vine
- Easily mechanizable, most vineyard equipment designed for single-canopies
- May have dense canopies prone to insect pests and fungal pathogens



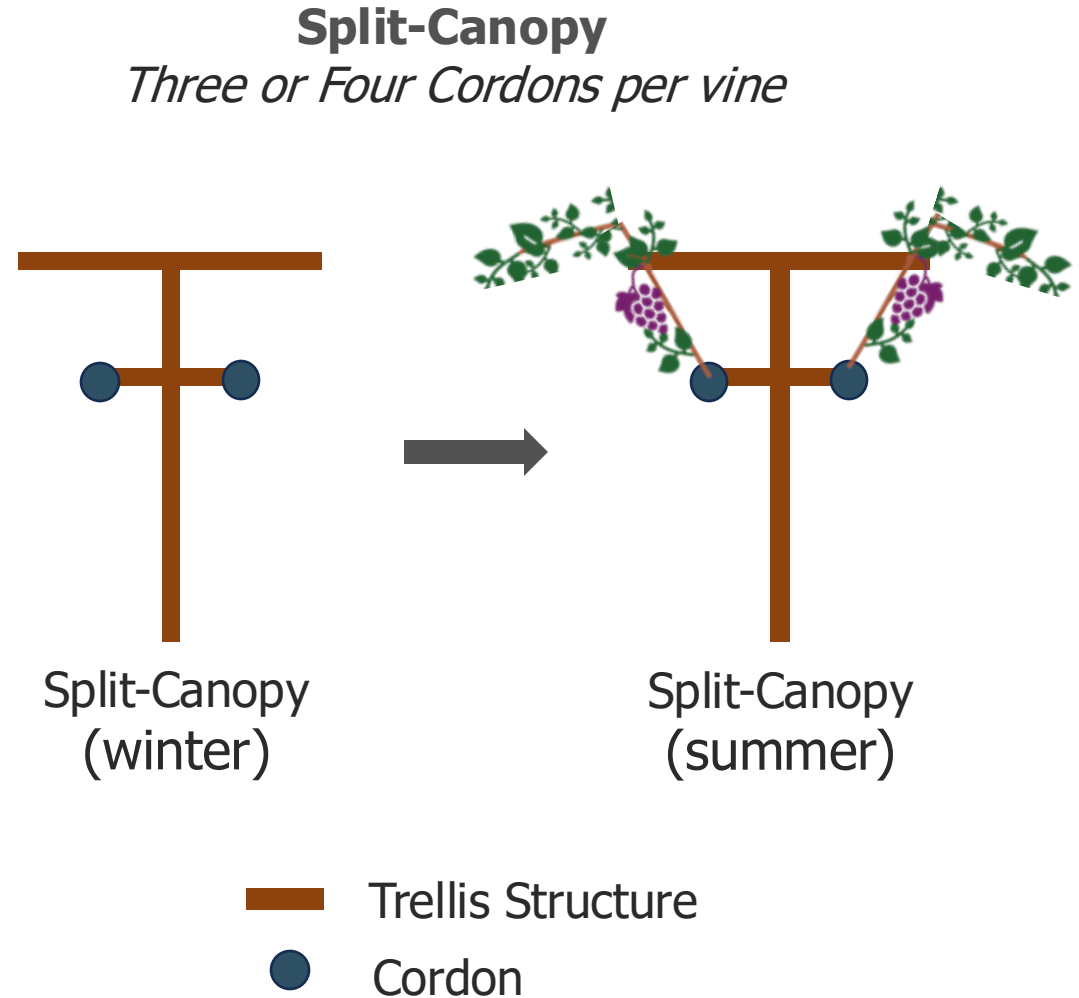
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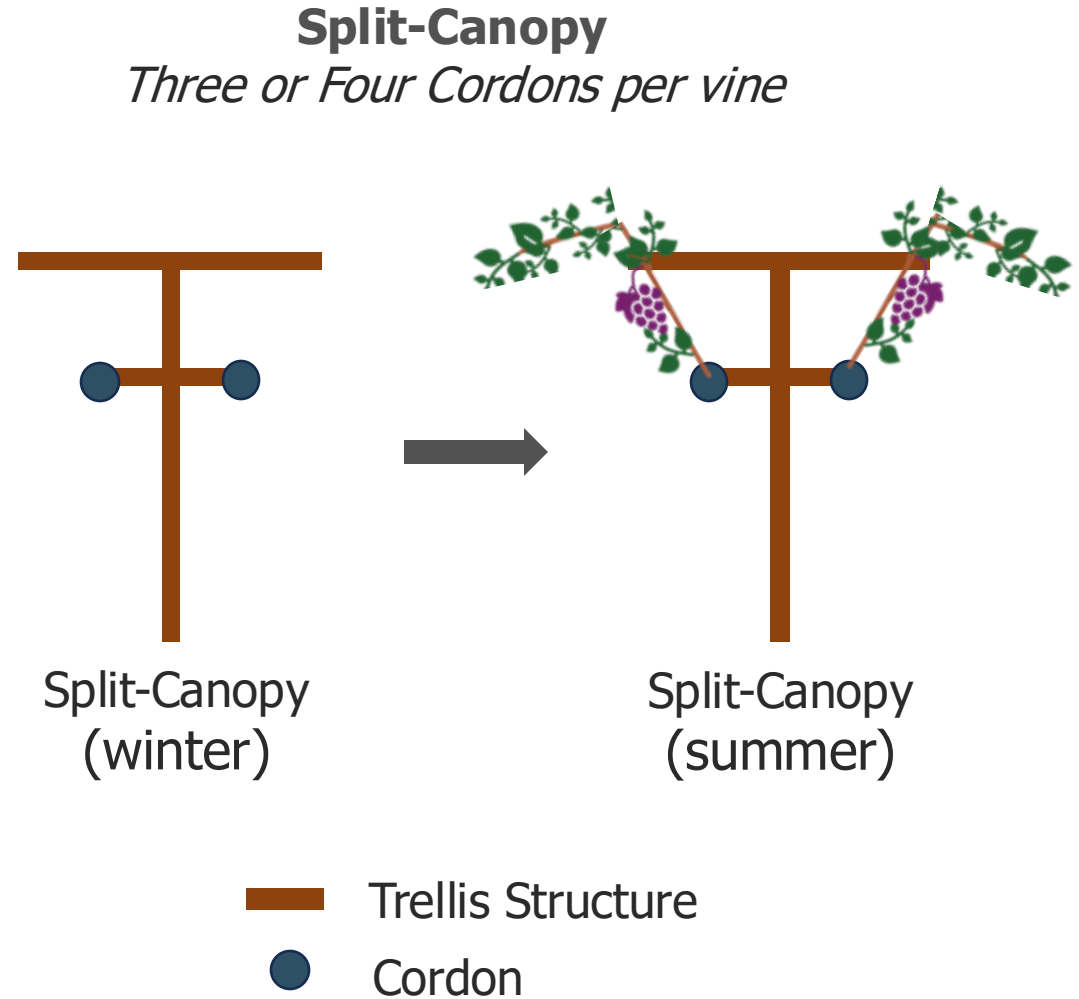
Split Canopy Systems

- Split Canopy trellis systems are divided twice after the trunk
- Two planes of shoots
- This means they may be trilateral, overlapping or quadrilateral systems
- Looks like two, parallel, single canopy systems grown from a single vine



Benefits and Detriments of Split Canopy Systems

- Provide more space for individual shoots to grow to grow
- Can allow for more buds per vine than single canopy trellis systems; helping to balance vigorous vines
- Often are difficult to mechanize
- Require wider row spacing than single canopy trellis systems



Side Quest - Irrigation

- 40 gpm = 2,400 gph well pump
- 1244 vines per acre
- 0.5 gph emitter (1x per vine)
- Required = 622 gallons per hour per acre
- How many acres can we irrigate at once?

$$\frac{2,400 \text{ gph pump}}{622 \text{ gph/acre}} = 3.85 \text{ acres}$$

- We have 10 acres, so we would divide irrigation into 3 separate blocks

Step 4 – Training the vine

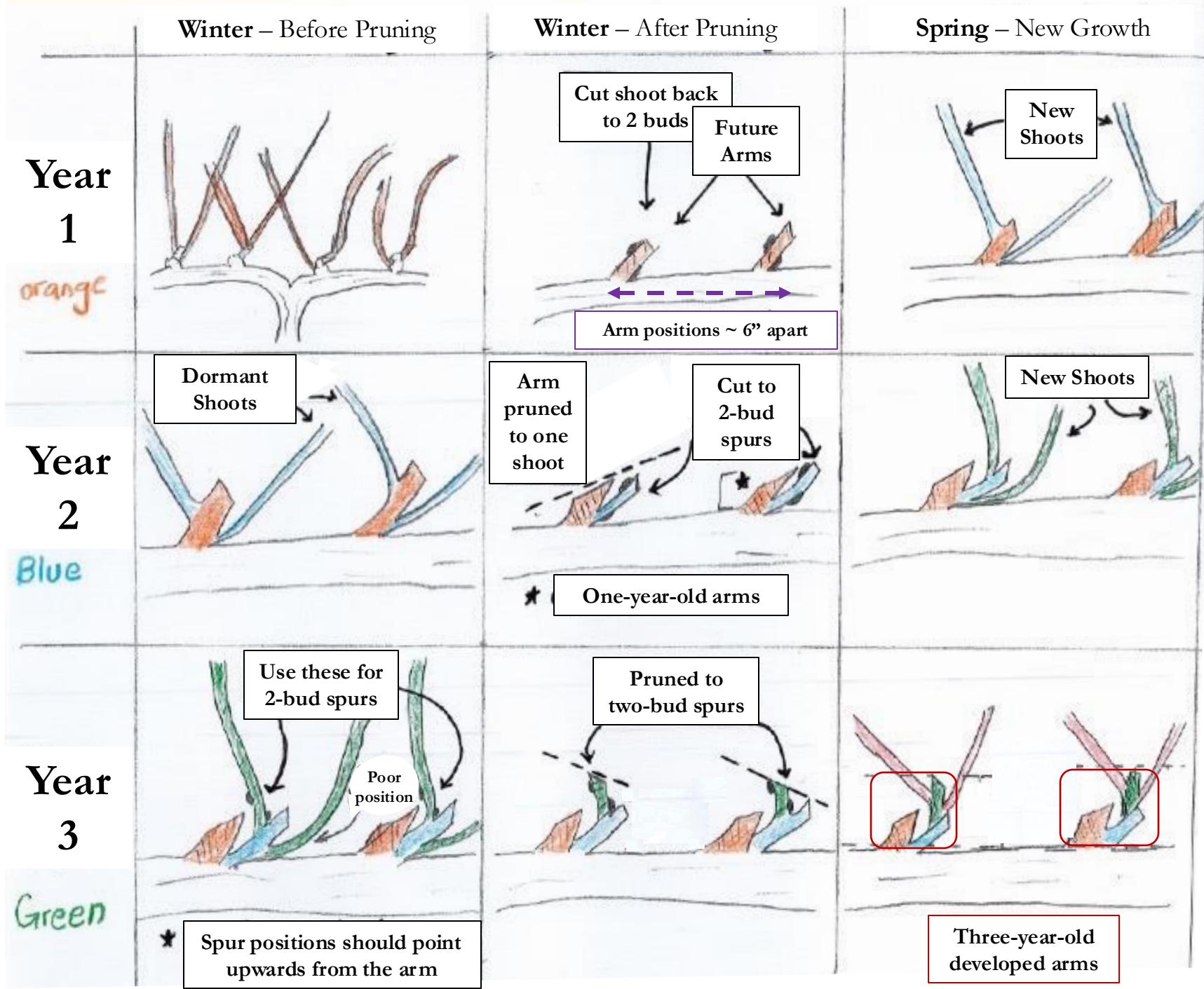
1. Year one
 - Leave it alone for one year
 - Cut back to 2-bud spur
2. Year two
 - Train the trunk
 - Remove any crop
 - If vigorous train the cordons
3. Year three
 - Train the cordons (if you haven't)
 - Allow ½ crop load on vines



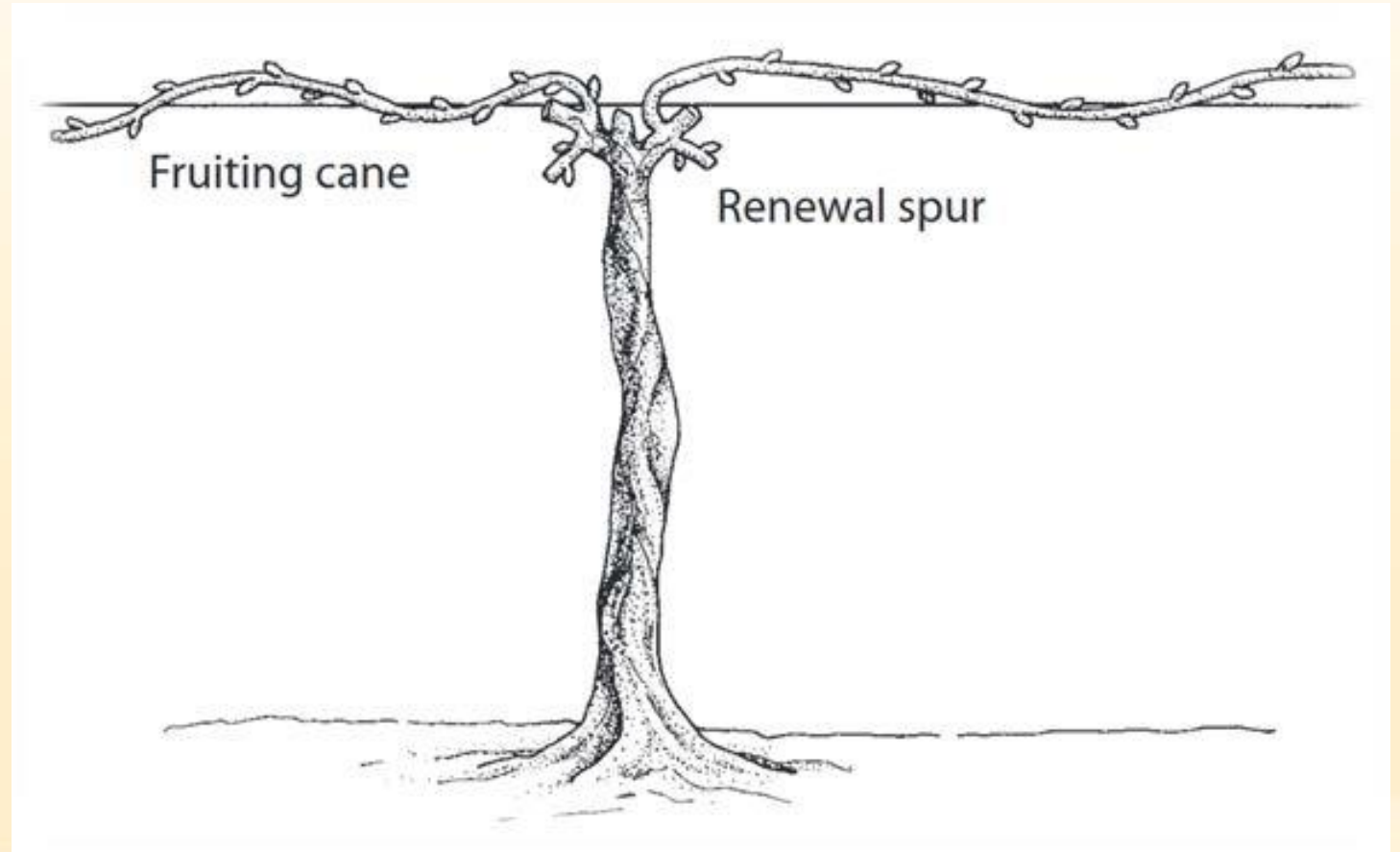


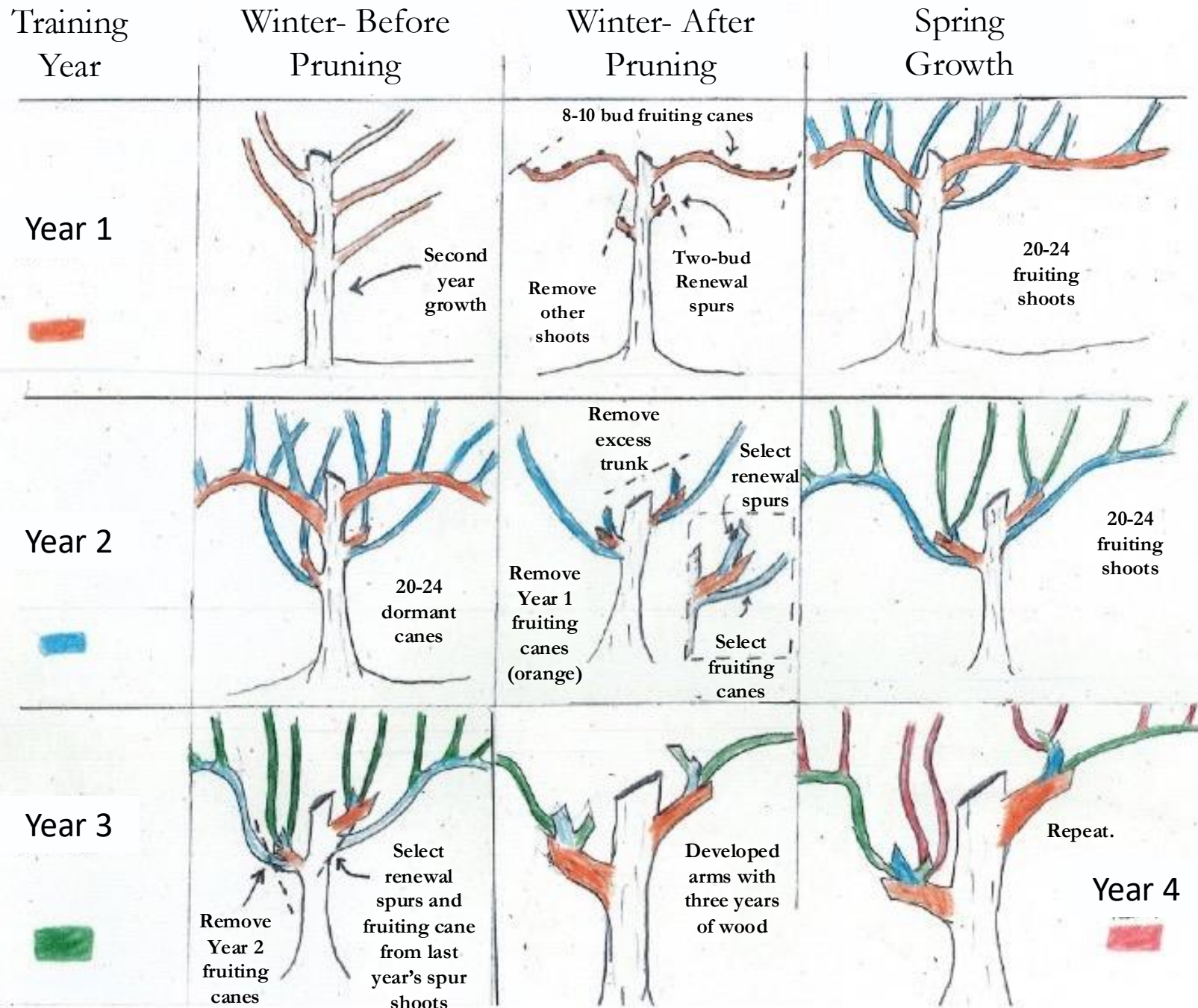
Cordon-Trained Spur-Pruned





Cane Pruned (Guyot Method)





Head-Trained Spur-Pruned



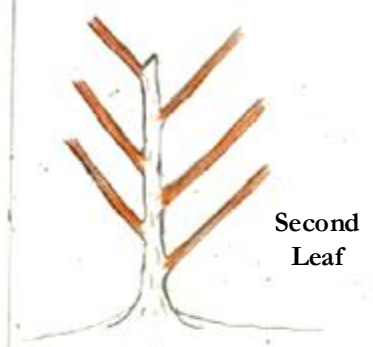
Training Year

Winter- Before Pruning

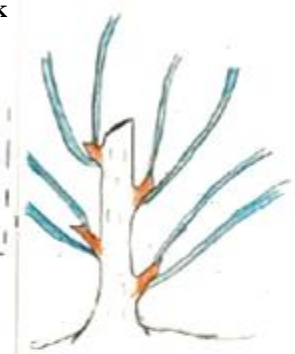
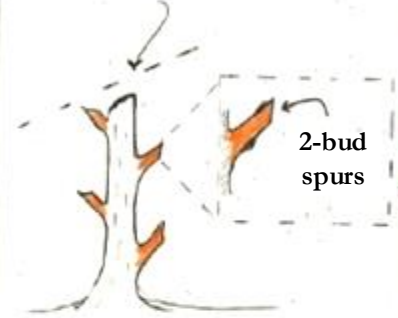
Winter- After Pruning

Spring Growth

Year 1

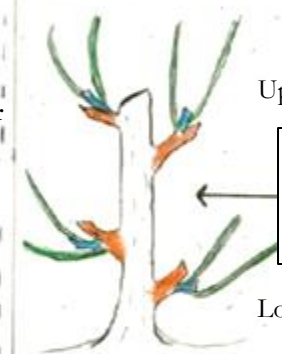
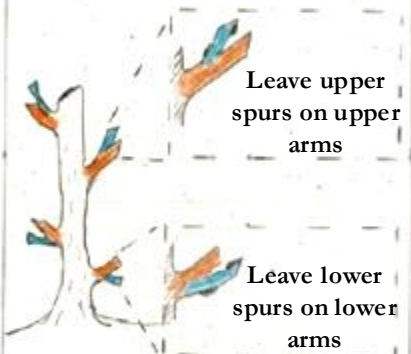
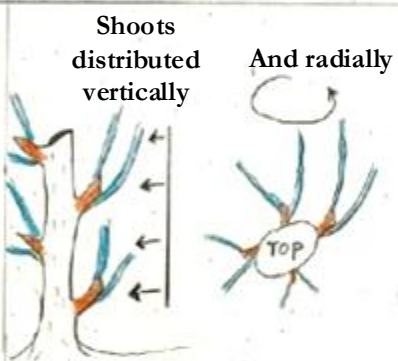


Remove upper shoots and trunk



New Growth

Year 2

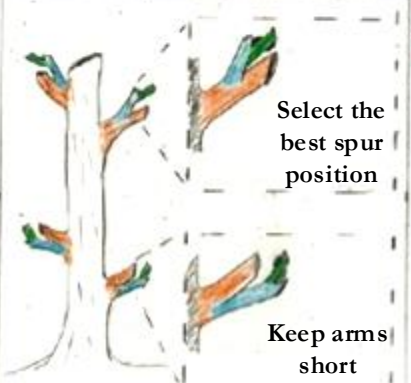
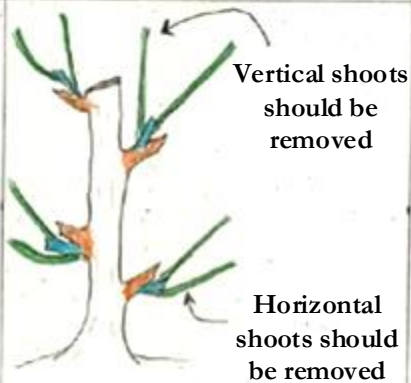


Upper plane

Separate the vertical cordon into two, horizontal planes

Lower plane

Year 3



Repeat.

Year 4



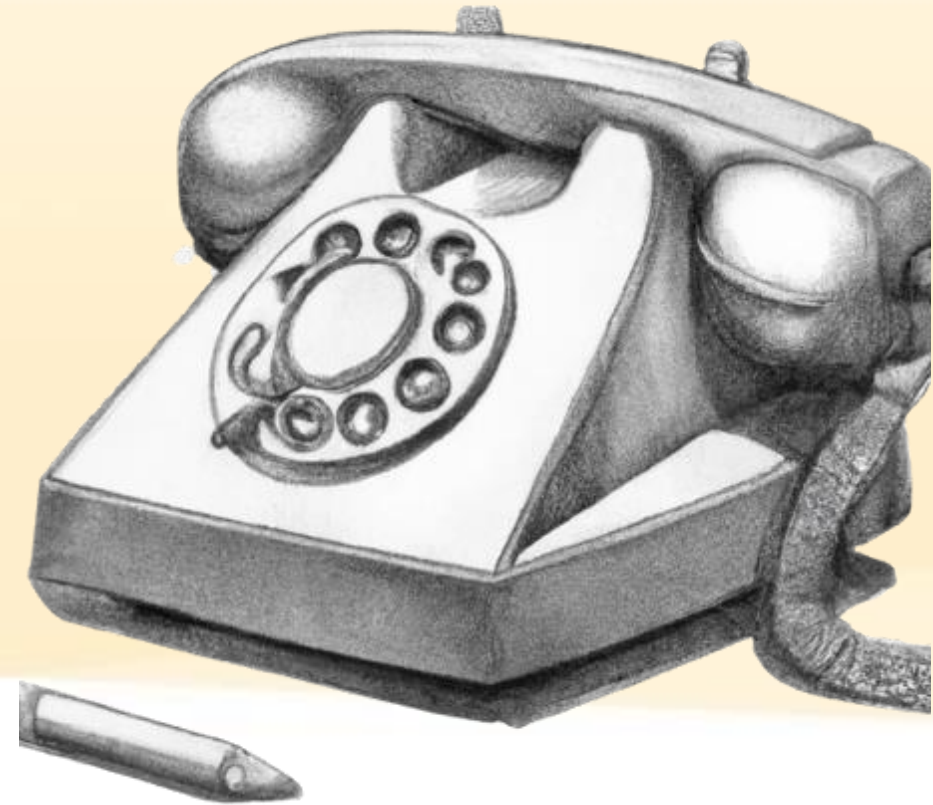
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 - We will create them if we don't already have them prepared for public use



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 1. <https://ucanr.edu/sites/chenlab>
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- Accompanying article published in Wine Business Monthly Online

Some original images created by OpenAI Labs Dall-E 3 Program and in <https://BioRender.com>

Useful Links

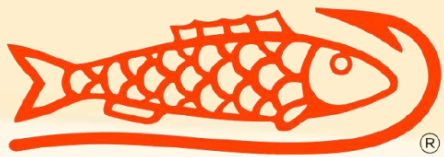
The following articles contributed information to this article. They have been provided as accessible hyperlinks for the reference of readers:

1. Mildews - <https://ucanr.edu/sites/eskalenlab/files/390126.pdf>
2. GTDs - <https://ucanr.edu/sites/eskalenlab/files/373935.pdf>
3. Pruning Protectants - <https://ucanr.edu/sites/eskalenlab/files/318632.pdf>
4. Invertebrate Pests - <https://ipm.ucanr.edu/agriculture/grape/#gsc.tab=0>
5. Viral Diseases - <https://ipm.ucanr.edu/agriculture/grape/virus-diseases/#gsc.tab=0>
6. Pierce's Disease - <https://ipm.ucanr.edu/agriculture/grape/pierces-disease/#gsc.tab=0>



Thanks for Listening

Thank you to
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providing the tools
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