

Viticulture

Wine 3 Introduction to Enology

1/21/2014

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Tonight's lecture

- Grapes that are used for winemaking
- Grafting and phylloxera
- Annual growing cycle of grapevines
- Determining ripeness
- Pruning and trellising
- Sustainable viticulture
- Grapevine pests

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Points to Consider

- Wine grape varieties are one of the few fruits that are chosen for flavor instead of ease of processing or appearance.
- Wine grapes are one of the few fruit crops that get picked when ripe.
- The quality of the wine depends on the quality of the grapes; the winemaker can preserve quality but it is difficult to improve.

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Quality comes from the Vineyard

- Opinions on the proper way to grow grapes vary as much as they do for wine making. There are many factors that influence the quality of grapes.



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Why grapes for wine?

- Because it is the perfect fruit for fermentation.
 - High concentration of fermentable sugar.
 - High nitrogen content for fermentation.
 - Natural association of yeasts and grapes.
 - Grapes have conditions that inhibit spoilage (high acid & tannins)

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Why grapes for wine?

- This is why the term "**wine**" has become synonymous with grape wine.
- Grapes are to winemakers as barley is to brewers.

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Fruit Wines

- Wine can be made from a number of fruits besides grapes.
- When making wine from fruit other than grapes it is often necessary to add sugar, water and nutrients to achieve a fermentable product that will make a stable wine.

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Which grapes to use for wine?

- *Vitis vinifera*, (*Genus species*) main grape grown world wide for wine, native to Asia Minor & Caspian Sea.



Zinfandel

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Vitis vinifera

- *Vitis vinifera* is by far the most widely planted variety in the world and accounts for the vast majority of wine produced.
- However it is not suited to every climate.

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Native American varieties

- *V. labrusca*, Concord (grape used in Welch's), Delaware (foxy, artificial grape flavor)
- *Muscadinia rotundifolia* Scuppernong (fruity flavor)
- *Vitis aestivalis*, Norton (delicate flavor)



Concord

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Which grapes to use for wine?

- **French American Hybrids**, attempts to mix winter hardiness and disease resistance with good flavors (with limited success).
- Examples are Maréchal Foch, Aurora, Chardonel, Seyval Blanc, and Vidal Blanc, mostly grown in the Eastern US.



Vidal Blanc

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Grape Varieties

- The different varieties of *vinifera* grapes are analogous to the different varieties of apples.
- All of these are the same species, *Malus domestica*.



Grape Varieties Handout

- In the links section of the website is a handout that lists varieties and their pronunciation.

Grape Name	Grape Pronunciation	A.K.A.	Color
Aggorigitiko	ah-jee-or-jee-tee-koh	Mavroudi	R
Aglianico	ah-LYAH-nee-koh	Elicico, Gnavico, Uva Nera	R
Aidani	ah-ee-THA-nee-eye-AH-nee	Aidani Aspro	W
Airen	IRHEEN		W
Aleatico	ah-leh-AN-tee-koh	Agliano	R
Albana	ah-BAH-nah		W
Albarino	AH-ba-REE-n'yo	Alvarino	W
Aligote	ah-lee-gaw-TAY	Chaudenet Gris	W
Alvarinlo	ah-vah-REE-nyon	Albarino	W
Aramon	ah-rah-MAWN		R
Arinto	ah-RIHN-toh	Arinto Pederna	W
Arneis	ah-NAYZ	Blanchetta	W
Asyrtiko	A SEER-tee-ko		W
Athiri	ah-THEE-ree	Thrapsthirli	W
Baco Blanc	BAH-Kow BLAHN		W
Baco Noir	BAH-koh NWAHR		R

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■ Grape varieties

- Estimates are there are more than 10,000 cultivars of *vinifera*. Here in California we grow only a few commercially, six varieties make up 80% of production. We will discuss grape varieties in detail in upcoming lectures.

■ Clones/Budwood

- A clone is a genetically identical group of plants from a single mother plant created by vegetative propagation.

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Clones continued

- Most *Vinifera* Clones have subtle differences in yield, flavor and aroma. The same clone will often act differently in different vineyards.

Species: *Vitis vinifera*

Variety: Pinot Noir

Clone: 667 (France)

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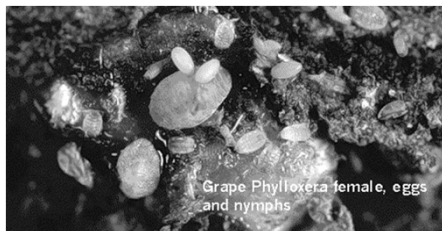
Clones & Quarantines

- Interest in the late 1800s in producing new varieties led to the importation of native American vines into France and with them their diseases phylloxera & powdery mildew. Today import quarantines seek to prevent new pests.

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Phylloxera

- A sap-sucking insect related to aphids that feeds on vine roots and causes galls to form, robbing vigor until the vine is killed.

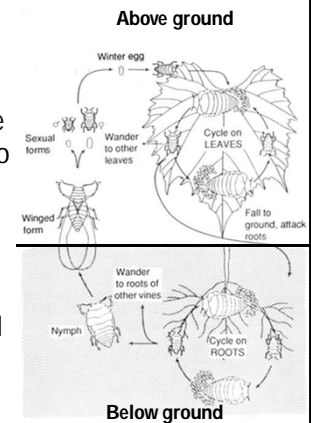


Grape Phylloxera female, eggs and nymphs

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Phylloxera

- In California it does not have a flying stage (conditions too dry) so it reproduces asexually.
- This means there is less genetic diversity and it does not spread as quickly.

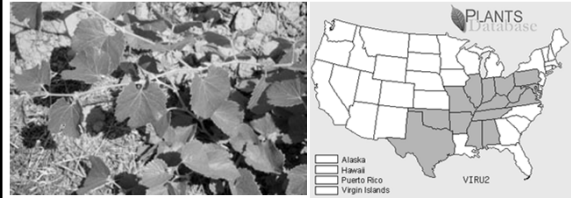


Rootstocks

- Necessary where **phylloxera** is present (or is likely to come). They are usually crosses between North American native species such as *V. berlandieri*, *V. riparia* and *V. rupestris*.
- These species evolved in the presence of phylloxera so they are naturally resistant to the pest.

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Rootstocks

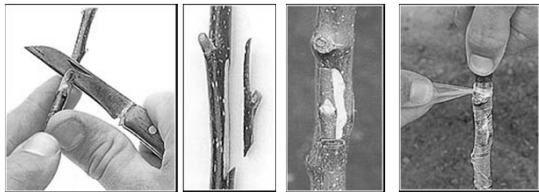


V. rupestris

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Grafting

- The process of grafting a vinifera (wine grape) variety onto a resistant rootstock, can be done after planting (chip budding or T-budding) or "bench top" before planting).

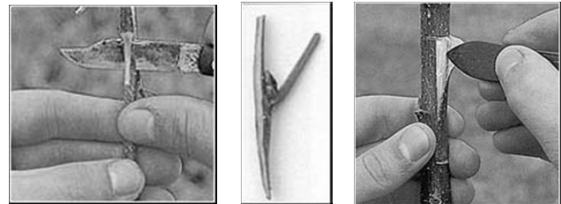


Chip Budding

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Grafting

- **T-budding**, on a young wine



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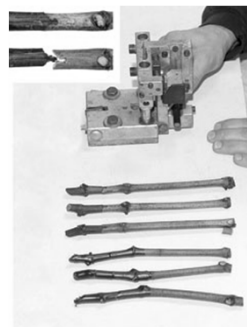
Grafting

- **T-budding**, can also be used for changing variety of mature vines.



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Grafting



bench top grafts fit like a mortise and tenon joint, best method for small scale growers.

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Phylloxera & AxR-1

- AxR-1 worked well for many years but in the 1980's a new type of more virulent phylloxera was found in CA, **Biotype B**.
- AxR-1 was a popular rootstock because it produced vigorous vines and was disease resistant. It was known not to be very resistant to phylloxera but it was incorrectly thought to be adequate for the conditions in California.

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Phylloxera & AxR-1

- This was a huge problem because 85% of California was planted on AXR-1 and Biotype B spread very rapidly.
- Replanting solved the problem but was expensive due to the cost of replanting and lost production.



St. George

AXR1

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Types of rootstocks

- **St. George**, used to be popular, produces vigorous vines (old vine Zin)
- **3309, 3916, Harmony, Freedom, 1103 Paulsen, & 5C** are currently popular. 5C is good for wet conditions, 3916 is resistant to oak root fungus.
- **110-R SO4, & 420-A** Low vigor, can be useful in high vigor situations.
- Link to rootstock chart on website

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Rootstocks Continued

- You should select the rootstock to fit the vineyards **terroir** (environmental conditions) just like you do when you select the scion. Also harder for pests to attack many different rootstocks.
- As an Example, 420-A does well in Lake County for Sauv Blanc, but not as good for Napa Cab Sauv.

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Own-rooted Vines

- Grapevines continue to be grown on their own roots in areas where phylloxera is not present such as Chile and Washington State. Strict quarantines keep the pest out, but growers in these areas are always nervous about it being introduced.
- If you don't have phylloxera, own-rooted is the best method.

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The Growing Season

- We will learn about how vines produce grapes by following the vines through the yearly cycle of the growing season.



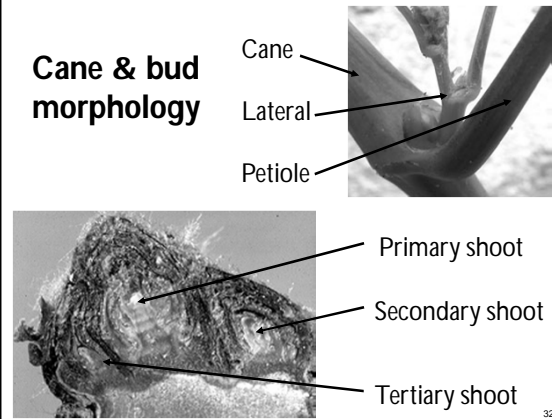
Bud break, early March 30

Fruit bud formation

- Buds form in the axial crotch of the leaf as the cane grows in the spring. Buds contain cluster **primordia**. The buds that will produce this year's crop were formed during the previous year's growing season.
- The fruitfulness of buds (# of clusters on shoot primordia) depends on exposure of light to the canes when they are formed "Sun Canes".

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Cane & bud morphology



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Budbreak

- Here in Sonoma County budbreak usually occurs in late February to early March.
- **Temperature** Bud break is temperature dependent on soil temperature. Wet soil warms up more slowly so during rainy years bud break delayed.

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Frost Damage

- **Frost** can damage or kill young shoots. If they are damaged secondary & tertiary shoots inside the buds take over, but they are not as fruitful.



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Frost Damage

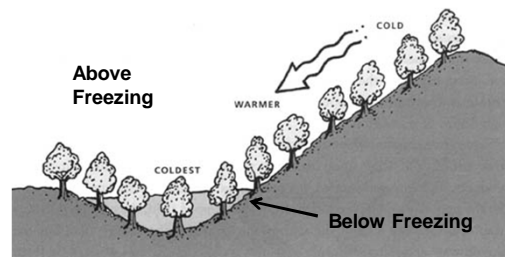
- The danger is usually over by mid May depending on the region. The low parts of the vineyard are most susceptible.



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Frost Protection

- **Hillside vineyards** have natural air drainage and usually do not need frost protection.



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Frost Protection

- **Wind machines**, with or without heaters, stir up inversion layer in air mixing warmer upper air with cooler ground layer air



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Frost Protection

- Shur Farms Fan & Vineyard heater



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Frost Protection

- **Sprinklers**, as long as ice is forming on the new shoots their temp will not fall below 32°F.



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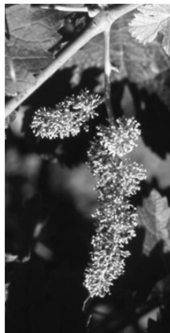
Spring Cultural Practices

- Spraying for control of rot and mildew
- Mowing or tilling
- Herbicide application
- Shoot positioning
- Suckering

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Bloom Set & Shatter

- Occurs about 8 weeks after bud break (May/June).
- **Bloom** Refers to the opening of the grape flower. Temperature dependent, it takes about 8 to 10 days over favorable conditions (warm, even temps). Varieties bloom in the order that they ripen in the fall.



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Bloom Set & Shatter

- **Set** (berry formation) Occurs when pollination achieves fertilization & seed development. Full clusters result from about 25% to 35% set.
- Influenced by:
 - Weather
 - Variety, Merlot can have difficulty setting
 - Excess Nitrogen (fertilization) causes poor set
 - Rootstock, 420-A used to achieve better set

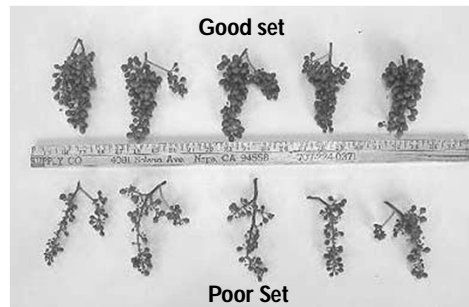
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Bloom Set & Shatter

- If these events happen over an extended period of time ripening is uneven. Too hot weather causes shatter, too cold weather prevents bloom.
- **Shatter**, the detachment of unfertilized berries from cluster, is what happens when the flowers don't set.

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Bloom Set & Shatter



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Berry Development

- **Green Stage** from set to the beginning of ripening. Berries slowly increase in size, sugar level and acid level. Sugar gets to about 3° Brix, malic & tartaric acids are synthesized, acid level is at its highest.

Grapes 3 weeks after bloom



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Berry Development

- **Véraison** Start of ripening. Color change occurs, berries soften, begin accumulating sugar, a very abrupt change.
- **vay-ray-ZON vs. ver-eh-shun**



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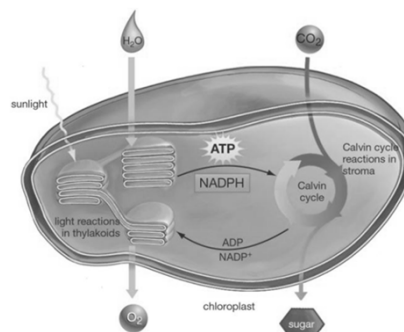
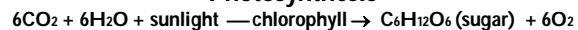
Berry Development

- **Ripening** Berry swells & softens, sugars accumulate in berries from leaf photosynthesis. Photosynthesis stops if it gets too hot to conserve vine water.

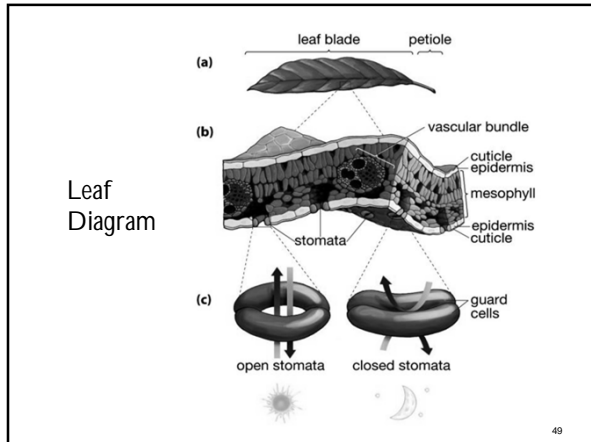


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Photosynthesis



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Ripeness

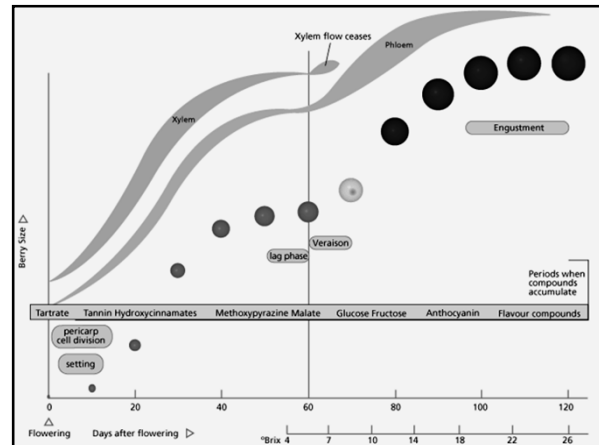
- **Tartaric and Malic** acid levels are stable until ripening begins. Acidity diminishes after véraison primarily from dilution. Malic acid is respired (used in berry metabolism) especially in hot weather.
- Malic acid can be metabolized at night without photosynthesis. This is why coastal areas with cool nights produce grapes with more acid than vineyards in the inland valleys.

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Ripeness continued

- **Tannins** and color compounds are formed (sunlight is required) and aroma compounds are formed.
- During this period shoot growth has slowed and less irrigation is required to maintain active foliage.

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Ripeness continued

- **Ripeness vs. Maturity**
 - Ripeness = adequate sugar concentration
 - Maturity = optimal flavor and aroma compounds
- Some feel that the longer grapes are on the vine without becoming over ripe, the better the flavor.
- The grapes think they are ripe as soon as birds want to eat them.

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Testing for maturity/ripeness Sampling

- Randomization is the most important aspect of grape sampling try to get random, **representative**, sample from all areas of the vineyard allowing for variation in the vineyard
- Get the sample the way the vineyard is going to be picked (divide the vineyard if it is going to be picked that way).

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Determining maturity/ripeness

- **Berry sampling**, pick about 100 to 200 berries from random places on the vine and clusters. This method is very accurate although it sometimes gives high results from novices, (because they only pick the plump berries on the outside of the cluster), uses less fruit gives less juice.
- I subtract 1 to 0.5 °Brix from a berry sample

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Determining maturity/ripeness

- **Bunch sampling**, pick about 20 to 40 bunches randomly this gives good numbers and is faster, uses more fruit and gives more juice.



Crushing a bunch sample

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Determining maturity/ripeness

- Both methods work, it's a manner of preference, a dartboard illustration compares *Accuracy vs. Precision*.



Accurate



Precise

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Determining maturity/ripeness

- While you are in the vineyard, evaluate for cropload, fruit condition, and **taste**. Grape seeds on red varieties become brown and crunchy when they approach ripeness.
- After the sample is taken, take it to the winery and crush & press and then analyze juice for sugar (°Brix), pH, TA and taste.

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Determining maturity/ripeness



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- **Harvest decision is based on the following:**
 - Flavor
 - Ripeness
 - Vine status,
 - Will the grapes get any better?
 - Weather forecast (short & long term) is it the end of the season?
 - Winery logistics, does the winery have room for the grapes.
- Harvesting is covered in detail in two lectures.

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Post Harvest

- After harvest irrigation can be done to give the vines some growth for sugar reserves.
- Pruning can begin after the first frost when winter comes and the vines go dormant (leaves fall off).



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Pruning

- Done during the dormant stage in winter. It determines the number and position of the buds and the crop load of the vine.



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Pruning

- Pruning establishes and maintains the vine in a form that facilitates vineyard operations.
- Vines pruned later in the year (Feb) will budbreak and ripen later, useful in areas of high frost risk.
- Growers must weigh risks of spring frost vs. late ripening

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Concept of Balanced pruning

- Divide the capacity of the vine between vegetative growth and fruit production to produce & mature as large a crop of high quality fruit as possible without weakening vine reserves.
- By keeping proper leaf/fruit ratio, about 6 to 12 cm²/gm of fruit, you can grow vines of almost any size.

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Winkler Vine

- Mission grafted on St. George ~ 60ft x 60ft



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Concept of Balanced pruning

- **Pruning to lightly**, leaving too many buds resulting in over cropping. Shorter shoots, may not ripen crop because of too much fruit to leaf ratio. Vines are depleted of reserves and will give a poor crop next year.

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Concept of Balanced pruning

- **Pruning too severely**, leaving too few buds leading to long vigorous shoots, laterals push using vine capacity, shaded fruit gives vegetative flavors, shade buds less fruitful so problem compounds itself next year.

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Cane Pruning

- Fruit canes of 2 to 5 feet retained along with renewal spurs (2 Buds) with 3-4 shoots/foot.
 - Needed for varieties with unfruitful basal buds (Thompson's Seedless).
 - Insures adequate crop load on small cluster wine varieties (Sauv Blanc, Pinot), or unevenly fruitful (straggly) clusters (Cab Sauv).
 - Main disadvantage it takes greater skill to select the best canes (size and position) & choose the correct # of canes/vine.

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Spur Pruning

- Most common because it is the easiest to prune; used with cordon or head training.
 - Permanent cordons (branches) have short canes or "spurs" with one to three buds on them.
 - Can have inadequate cropload on small-clustered varieties.

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Concept of Balanced pruning

- In vineyards that have higher capacity (warmer climate, richer soils, plenty of water) the vines can support higher crop loads with the proper trellis and canopy management and still get the grapes ripe in a reasonable amount of time.

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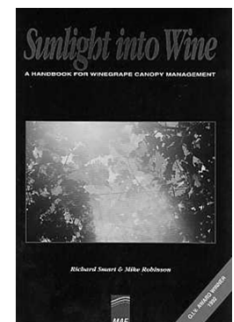
Trellising

- Positioning of vegetative growth to optimize fruit quality. Traditional (single curtain canopy, unshoot positioned) can result in shading in high vigor situations.
- In cooler climates optimizing sun exposure to maximize photosynthesis & ripening is a goal.
- Exposed clusters facilitate air circulation so clusters stay dryer and sprays penetrate better.

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Trellising

- The subject of trellising, crop balance and canopy management is covered in the book ***Sunlight into Wine***, Dr. Richard Smart.



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High vigor situations

- **Devigorize**, less irrigation, plant competing cover crops, close spacing, and devigorizing rootstocks so foliage can be controlled balancing the vine.
- **Utilize vigor**, spread big vine over a big area can increase yield as well as quality, maximizes sun exposure to the leaves.

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Types of trellis

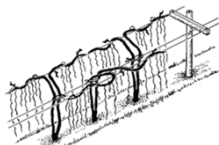
- **Double Curtain**
 - U System-Quadrilateral
 - GDC (Trained Down)
 - Lyre
- All of these are shoot positioned.



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Types of trellis

- **Geneva Double Curtain**



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Types of trellis

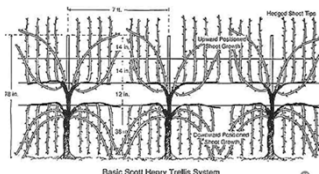
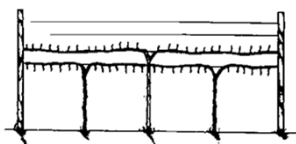
- **Single curtain VSP** (Vertical Shoot Positioning), cane or cordon, currently one of the most popular in the North Coast, can be mechanically harvested.



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Types of trellis

- **TK2T** (Te Kauwhata 2 Tier), **Scott Henry / Smart Dyson**. Two curtains one above the other. The lower tier usually ripens after the top tier



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Trellising Cont.

- Trellising does not solve every problem and in some low vigor vineyards they can make things much worse by over cropping.
 - Mondavi found that close spacing worked better for them than split-canopy trellising.
 - An elaborate trellis system can lower the quality of a vineyard if done improperly.
 - Lower croploads does not always mean better quality.

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Things to consider with trellising

- Cost, is it worth the investment of materials and labor.
- How it affects cultural practices (VSP is good for mechanical harvesting).
- One problem with fancy trellis systems is that they can be easy to over crop.
- Double curtain trellises originally became popular because in many vineyards vine rows were spaced too far apart.

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Nutritional requirements of grapes.

- Grapes can grow in very poor soils, but are healthier in good soils, needs are complex and deficiencies are hard to diagnose.
- The French have a saying "***If Bordeaux didn't have the best soils in the world they would be the worst***". Many feel that stressed vines produce more intensely flavored fruit.

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Water

- The most important "nutrient" necessary for photosynthesis allows growth during the vegetative growth phase you don't want water stress here, steady supply better than on and off irrigation.



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Water

- You want water to become less available later in the season so the vine to concentrates on ripening, not vegetative growth.
 - Water from irrigation or rain pumps up (dilutes) berries when given right before harvest.
 - During heat waves the vine will take water from the berries, irrigation at this time can help keep berries from turning to raisins.

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Nitrogen

- Nitrogen is needed to grow proteins and enzymes. Commonly applied to ground before last winter rains it can also be applied through drip lines examples: KNO_3 , $\text{Ca}(\text{NO}_3)_2$, nitrates.
- Most North Coast vineyards do not require much nitrogen, in the Central Valley, with its high croplands, more nitrogen fertilizer is needed.

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Potassium (K^+)

- Very important in sugar synthesis.
 - **Summer Sickness** (K^+ deficiency) looks like water stress. In grape juice K^+ combines with HTa^- (bitartrate) and precipitates (this is cream of tartar). Applied as potash (Potassium Carbonate - K_2CO_3) in holes.
 - High [K^+] can also be a problem, causing high TA's and high pH (K^+ exchanges with H^+ in the berry) Adversely affecting wine stability and flavor.

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Other important nutrients

- 1. P Phosphorus
- 2. Mg Magnesium
- 3. Zn Zinc

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Terroir

- **Terroir** (The Growing Environment)
 - Holistic term that refers to everything that contributes to the environment of the vineyard, Soil, Micro/Meso & Macro Climate, Relief, Exposure, etc.
 - Many people incorrectly think that this only refers to the soil.

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Terroir

- **Micro-Meso-Macro Climate**
 - Macroclimate refers to the climate in a large area (Sonoma County)
 - Mesoclimate refers to the climate in a smaller area (a particular vineyard or appellation)
 - Microclimate refers to climate around a given vine or portion of a vineyard.
 - Meso/macro terms often interchanged.

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Terroir

- Climate/Weather, naturally there is a great deal of variation from year to year. In a hot year a vineyard that is normally too cool may be great.
 - Enough sun & heat to get variety ripe
 - Effects of bad weather hail, rain, rot
 - Cool weather associated with more aroma compounds and higher acid levels.

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Terroir

- Soil Composition
 - Stony soils hold less water so they warm up faster in cold areas.
- Relief/Aspect
 - South facing vineyards are warmer than north facing vineyards.

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Vineyards in the Rhine



- These vineyards in the Rhine lie at the same latitude as Vancouver BC. Rocky soils and south facing hillsides help them to get ripe

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Terroir

- **Variety suitable to site.** Choice of grape, ideally a variety that will fit the **terroir**; although you can do some bending by cultural practices.
- This is very important to grape quality, and you live with this choice unless you T Bud which is not easy (*or cheap*).
- Example: Vigorous growers may be more suitable on poor soils.

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Heat Summation

- **Heat Summation or degree-days:** Sum of the mean daily temperatures above 50 °F (chosen because almost no shoot growth below this temperature). This is not used as much as it used to be, but it is a good rough estimate of climate.
- For these calculations a growing season of April 1 to October 31 is used.

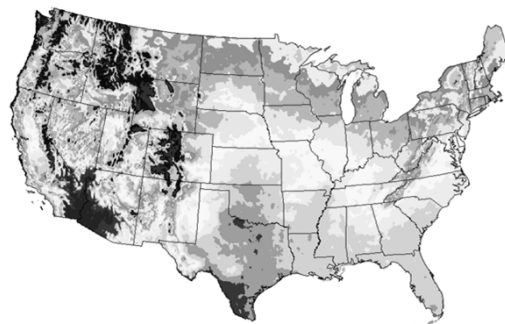
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Heat Summation

- Example: If 70 °F is the mean temp for the day than the summation is 20 °F
 - Region 1 <2500 Anderson Valley, Carneros
 - Region 2 2500 to 3000 Napa, Petaluma
 - Region 3 3001 to 3500 St Helena, Cloverdale,
 - Region 4 3501 to 4000 San Luis Obispo, Davis
 - Region 5 >4000 Fresno, Bakersfield

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Heat Summation



US Degree Days

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Heat Summation

- **At Best** Heat Summation is used as a rough estimate, micro/meso climate is just as important. Think of it as the minimum needed to get things ripe.
- This does not tell the whole story: latitude factors in with length of days. In Washington State for example there are less days in the growing season but more sunlight per day.

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Cultural practices

- **Cultural practices**, pruning, plowing, irrigation, trellising, everything that you can do with the Vineyard.
 - Trellising and leaf pulling affects Sauv Blanc aromas. Light exposure on the clusters is greatly influenced by trellising; anthocyanins & phenolics require light for synthesis
 - Fruit thinning on Zinfandel improves flavor

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Sustainable Viticulture

- Vineyard operations that do not degrade the land or the surrounding environment.
- Minimal use of pesticides, reduce tilling to preserve soil, encourage a natural vineyard ecosystem with predatory insects.

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Sustainable Viticulture

- Often a small amount of herbicide is sprayed at the base of the vine to control weeds.
- Sustainable viticulture provides much of the benefits of organic farming, with less risk and cost.
- Take into account the carbon footprint of your vineyard.

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Organic Viticulture

- Incorporates all of the practices of Sustainable Viticulture but does not allow the use of synthetic chemicals.
 - Sulfur can be sprayed as a fungicide.
 - Tilling and hoeing is done to control weeds.
 - Constant vigilance is required to make sure small problems do not become large ones.
 - Currently about 2% of California vineyards are organically farmed, popular in Mendocino Co.

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Biodynamic Viticulture

- Similar to organic viticulture but it also has spiritual, astrological, and homeopathic elements.
 - Proposed by Rudolf Steiner in 1924 to combat the degradation of the environment caused by the standard agricultural practices of the time.
 - Sees the farm as a holistic entity.
 - Often when it is promoted in marketing materials its more esoteric practices are unmentioned.
 - Gaining in popularity, not been much research has been done to prove it grows better fruit.

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Organic Wines

- Organic wines are wines made with organic grapes that do not have added sulfur dioxide.
- They still contain a small amount of natural sulfur dioxide and tend to have a very short shelf life.

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Growing superior wine grapes

- Like all crops the quality is based on the vines suitability to the site and the amount of work that is put into the vineyard.
- **Quality over quantity**, sometimes this is expensive, but this is the only way to make the best wine.
- Important not to see grapes as a commodity that has a uniform value.

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Growing superior wine grapes

- It is the wineries responsibility to make sure that the grower is properly compensated for extra effort.
- It is the growers responsibility to make decisions based on quality and not yield.
- Sometimes grapes are sold by the acre rather than the ton or by percentage of the bottle price

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Pest Management

- We won't cover pest management in depth in this class but we will go over Pierce's disease, Vine Mealybug, Light Brown Apple Moth, and European Grape Vine Moth because they are in the news.

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Pierce's disease

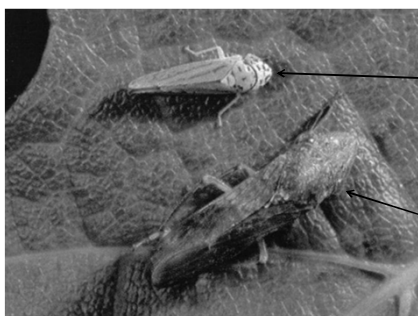
- Pierce's disease is native to California and lives in host plants in riparian areas. There have been two large historical outbreaks 1883 to 1886 in Anaheim and 1937 to 1944 in San Joaquin Valley. Has always been a low-level problem throughout the state.

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Pierce's Disease

- Pierces disease is caused by a bacterium, *Xylella fastidiosa*, it infects grapevines and kills them by blocking xylem transport.
- Traditionally spread from creeks (riparian areas) to vines by the **Blue-green Sharpshooter Leafhopper** it is now being spread by a more aggressive pest the **Glassy Winged Sharpshooter (GWSS)**.

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Blue-green Sharpshooter

Glassy-winged Sharpshooter

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The Glassy Winged Sharpshooter

- The Glassy Winged Sharpshooter, *Homalodisca vitripennis*, is larger than the Blue-green Sharpshooter (about ½ an inch long and brown) and is native to the South Eastern U.S. It was introduced to southern CA. in the early 1990's and quickly began to spread PD.
- Problem was mostly ignored until Temecula was badly infected. Spread to new areas by importation of ornamental plants.

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The Glassy Winged Sharpshooter

- GWSS caused a lot of fear in 2002 but it turned out not to be the end of the world.
- Actions taken to control pest:
 - Quarantine transport of host plants.
 - Research into control of disease.
 - Parasitic wasps.

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Vine Mealybug

- Vine Mealybug (VMB) *Planococcus ficus* is an invasive pest that is native to the Mediterranean region. It first came to southern California through Mexico in 1994. In recent years it has moved into the North Coast.
- Large infestations can lead to defoliation, berry damage and rot.

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Vine Mealybug



Female Vine Mealybug



Honeydew from
Vine Mealybugs

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Vine Mealybug

- VMB can feed on all parts of the vine.
- They overwinter underneath the bark or underneath the soil so foliar insecticides have limited effectiveness.
- In addition to grapes they can feed on figs, apples, citrus, and avocados.
- Ants in the vine can be a sign of infestation.

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Vine Mealybug

- Treatments include:
 - Parasitic insects
 - Pheromone traps
 - Insecticides
- A growing problem but like the GWSS a lot of effort is being put into finding solutions.

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Light Brown Apple Moth

- Light Brown Apple Moth (LBAM) *Epiphyas postvittana*. Native to Australia, it is a recently introduced pest that feeds on a number of crops.



Larvae



Adult

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Light Brown Apple Moth

- So far has caused little economic damage to California Crops.
- Being addressed with:
 - Quarantines on moving plant materials: grapes, stems etc.
 - Parasitic wasps
 - Pheromone traps
 - Does not appear to be a threat

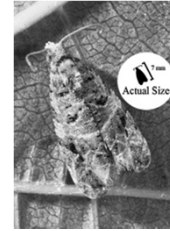
115

European Grapevine Moth

- European Grapevine Moth, *Lobesia botrana*, it was first found in the Napa Valley in 2009.



Larvae



Adult

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European Grapevine Moth



2010 Quarantine Map

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European Grapevine Moth

- Unlike the LBAM this could cause serious economic damage to California Crops.
- Larvae feed on flowers and inside the berries.
 - Quarantines on moving plant materials: grapes, stems etc.
 - Pheromone traps
 - Insecticide, aerial (very unpopular) and ground spraying.
 - Program looks like it is working

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- **Disclaimer.** Viticulture is just as big a subject as winemaking and there is a lot of material that we did not cover.
- For more information there are UC extension classes as well as many viticulture classes available here at SRJC.

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In Two Weeks

- Basic chemistry review
- Alcoholic fermentation
- Malolactic fermentation
- No lab this week

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