

Common Grapevine Cultivars used for Production

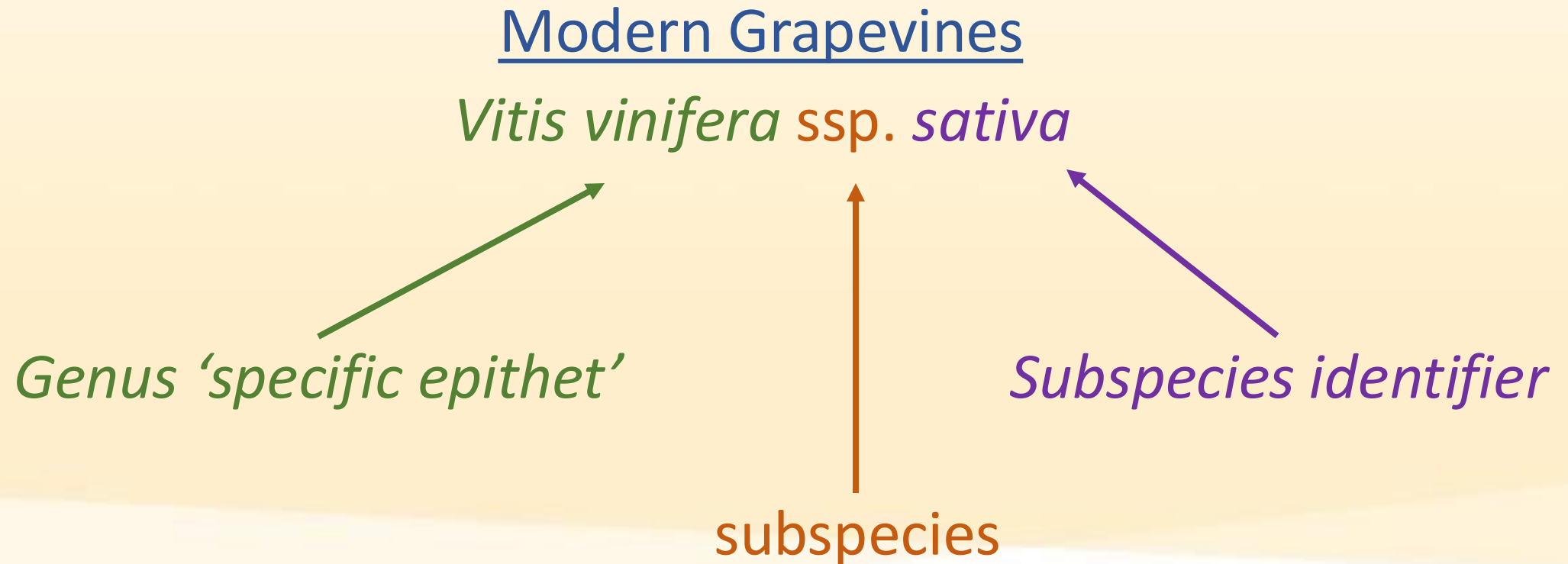
UCCE North Cost Viticulture

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North Coast

Nomenclature of Grapevines



Nomenclature of Grapevines

Genus – *Vitis*

- Many grapevines belong to *Vitis*
- Some belong to different genus (e.g., Muscadinia)

'specific epithet' – *vinifera*

- Most grapevines grown for food or wine
- Countless other specific epithets that are still considered 'Grapevines'

Nomenclature of Grapevines

Subspecies (ssp.)

- Common way to further delineate members of the same specific epithet
 - i. Example: *Cannabis sativa ssp. sativa*; *Cannabis sativa ssp. Indica*

Subspecies name – *sativa*

- Two very common subspecies names:
 1. *Sativa* = 'Cultivated'
 2. *Sylvestris* = 'Of the Woods'
- Wild ancestor of today's grapevines = *Vitis vinifera ssp. sylvestris*

Other Grapevine Species

There are hundreds to thousands of grapevine species.

Many of them are not useful to us

1. Clusters are too small
2. Not easy to propagate
3. Inconsistent
4. Taste bad



Centers of Origin for Grapes

There are currently three, accepted regions of origin for *Vitis*

1. Middle East – *Vitis vinifera* and *Vitis jacquemontii* (aka *lantana*)
2. Asia – *Vitis amurensis*, *Vitis davidii*, and about 34 more
3. North America – About 30 – 50 accepted species

California has **two native species**

1. *Vitis californica*
2. *Vitis girdiana*

Scions – Species to Consume

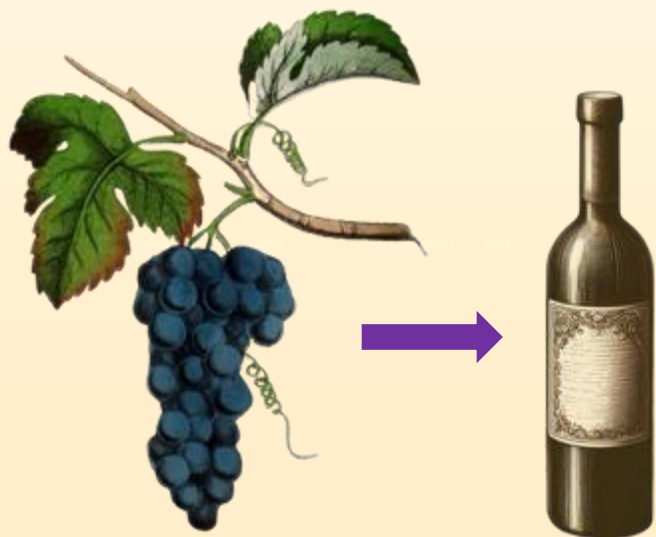
There are three main species of *Vitis* used for food/wine:

1. *Vitis vinifera* – the one all around us in California
 - i. Used for table, raisin, and wine grapes

2. *Vitis labrusca* – also called Concord grapes
 - i. Used most commonly for Jellies, Jams, Juice, and Flavoring

3. *Vitis/Muscadinia rotundifolia* – We don't eat these here
 - i. Usually consumed as a table grape

Common Grapes for Food/Wine



V. vinifera

Wine; Table Grapes; Raisins



V. labrusca

Juice; Jams; Flavorings



M. rotundifolia

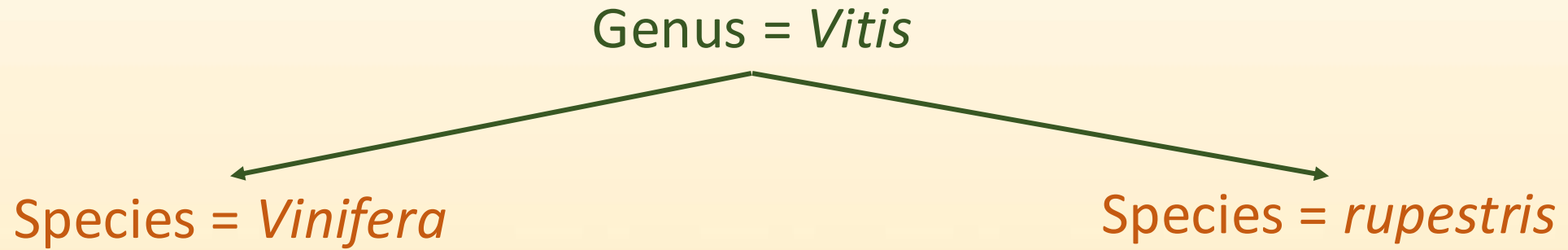
Juice; Wine; Flavorings

Cultivars & Clones of *Vitis vinifera*

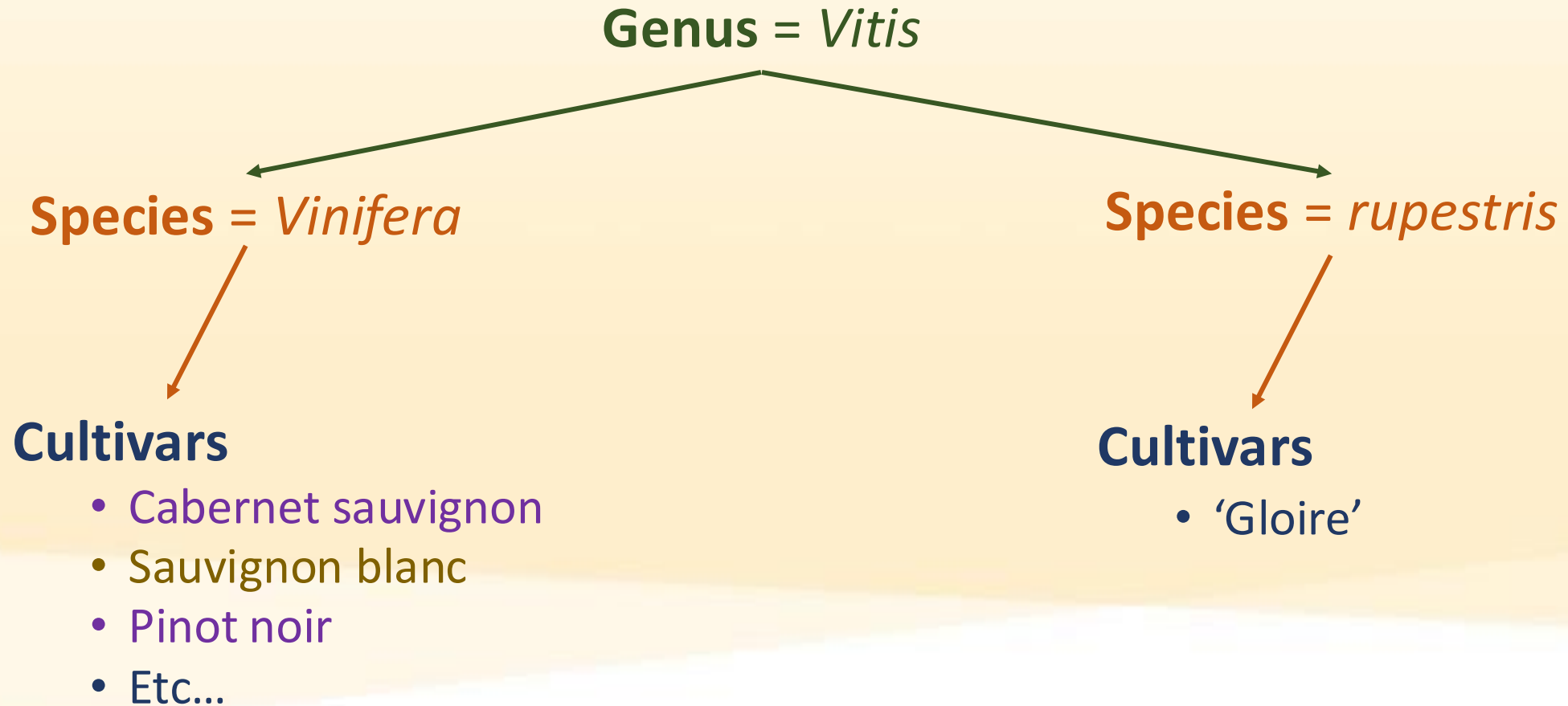
Hierarchy of Classification

Genus = *Vitis*

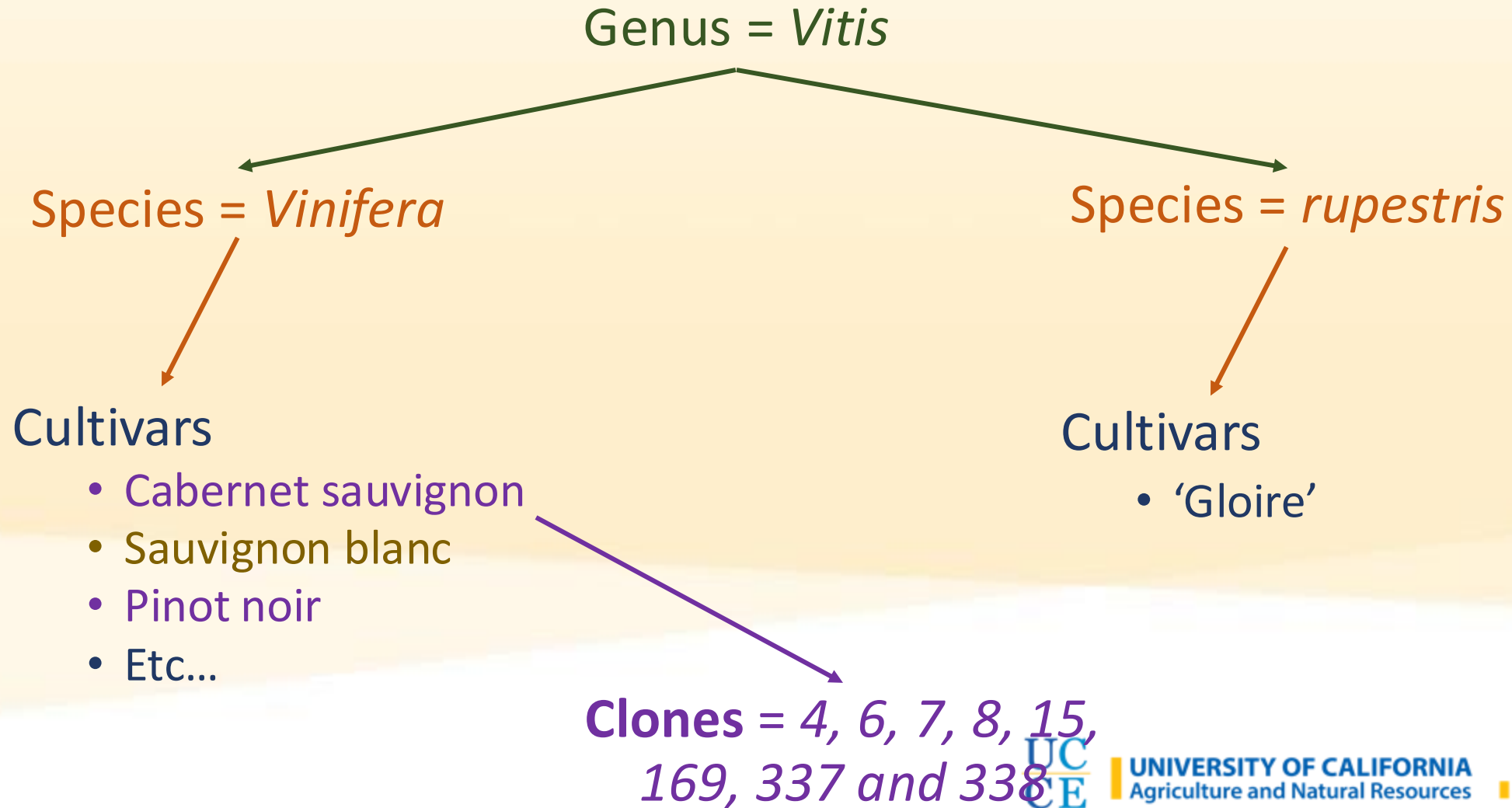
Hierarchy of Classification



Hierarchy of Classification



Hierarchy of Classification



Cultivars

Cultivars can be viewed as different dog breeds. They are still all dogs but have **unique traits** that make them different from others.

It's the same concept with grapevines. All *cultivars* of *Vitis vinifera* are still the same species, but each has its own unique qualities that differentiate it from others.



Example: Pinot noir and Pinot blanc

Major Wine Grape Cultivars in California

There are a handful of winegrape cultivars grown in California. These account for the majority of the grapes in the state.

Currently the top 5 are:

- | | | |
|----|--------------------|---|
| 1. | Cabernet Sauvignon | 20.5% of all wine grapes (95,512 acres) |
| 2. | Chardonnay | 19.5% of all wine grapes (90,228 acres) |
| 3. | Pinot Noir | 10.2% of all wine grapes (47,245 acres) |
| 4. | Zinfandel | 8.5% of all wine grapes (38,966 acres) |
| 5. | Merlot | 7.5% of all wine grapes (34,671 acres) |

Clones

Clones are further differentiated within cultivars.

But they are all the same cultivar/variety

Think about the different color patterns of Huskies

Some of the factors that can justify a new clone are:

- Specific traits like disease resistance or smaller canopies
- Earlier or later budbreak and/or fruit maturity
- Different colored grapes
- A specific source (e.g., Wente Clone of Chardonnay)



Clones

Originally introduced in the 1960s as a way to guarantee
“Virus-free material”

Harold Olmo of UC Davis started this trend by taking a cutting of Pinot noir from Pommard, France.

Soon evolved to focus on desirable traits of the clone rather than just ensuring ‘clean material’

Common Clones

Major clones of popular cultivars in California

1. Cabernet Sauvignon = Clones 4, 6, 7, 8, 15, 169, 337 and 338
2. Chardonnay = Clones 4, 5, 6, and 108
3. Pinot noir = Clones 115, 667, and 777 (Dijon clones)
4. Zinfandel = Clone 08 (local), 13, and 16
5. Merlot = Clones 1, 3, 6, 8, 9

Scion Variety Bottleneck

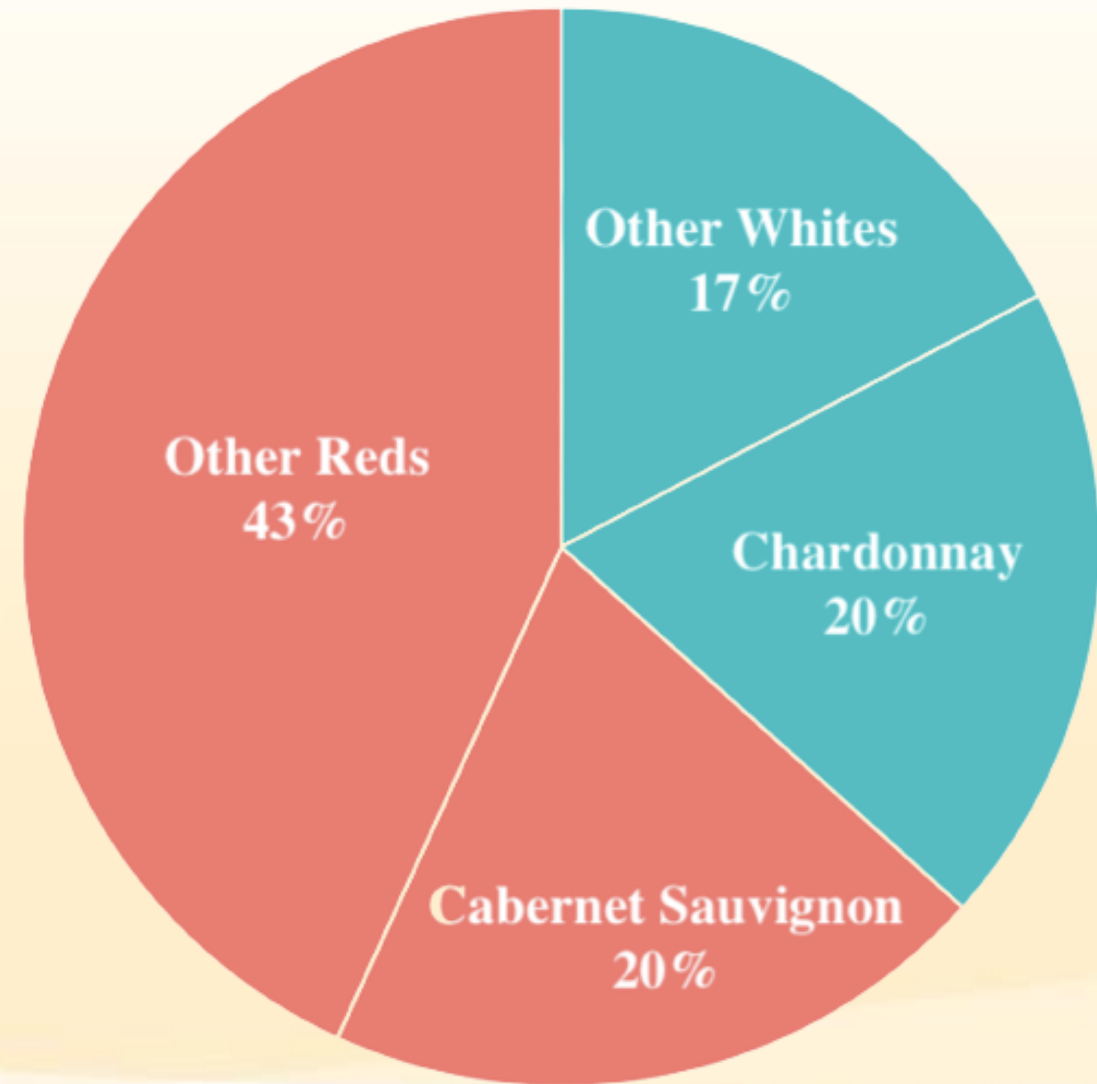
Market limitations on profitable cultivars

Bottleneck down to two scions

Wide range of temperature adaptation in scions

Desirable characteristics:

- i. Late budbreak (avoid frost)
- ii. Moderate vigor (less water demand)
- iii. Early fruit maturity (maybe)
- iv. (e.g., Sémillon; Tempranillo)



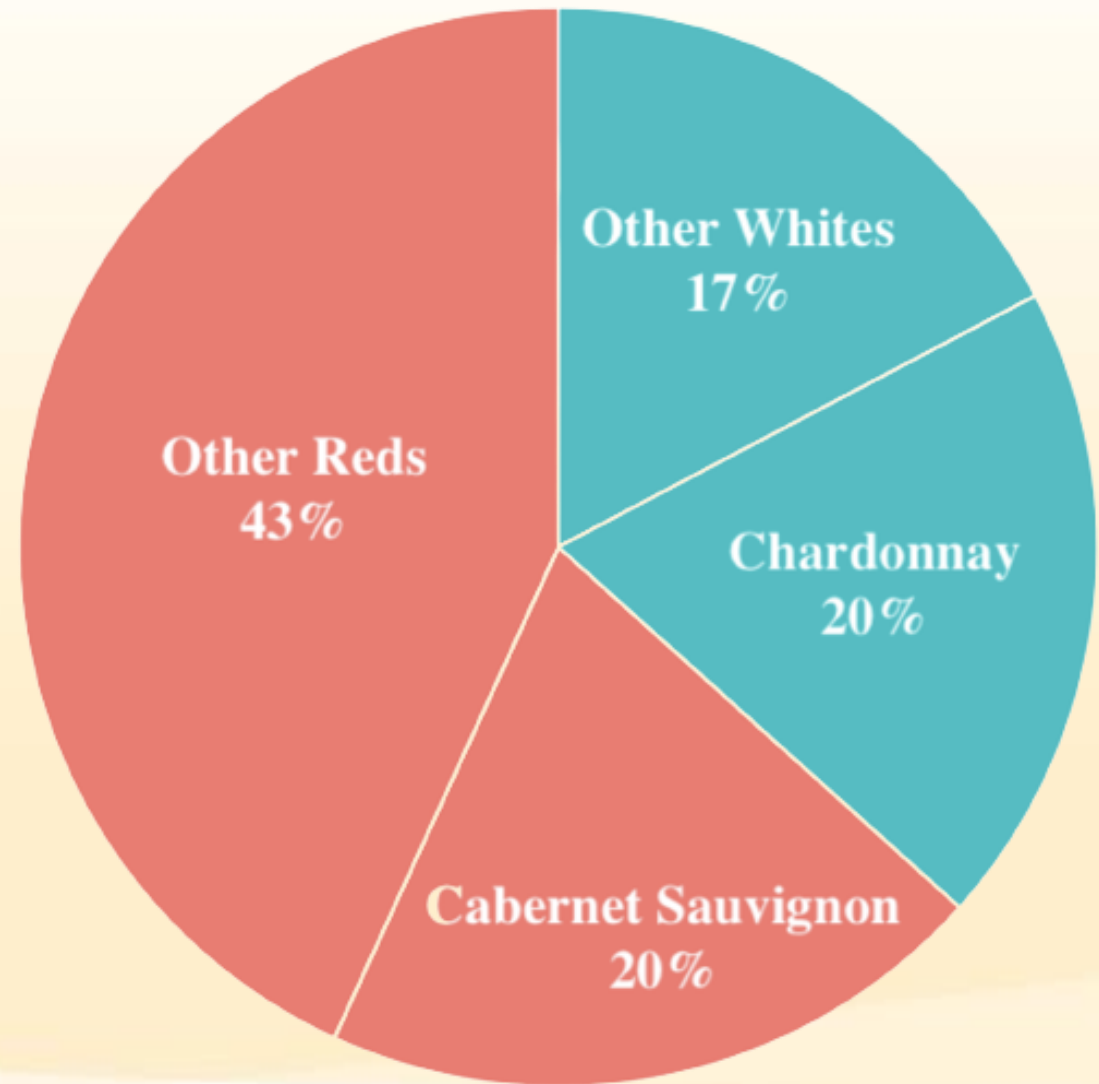
CA Grape Acreage Report (2020)

Scion Variety Bottleneck

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CA Grape Acreage Report (2020)

Grape Varieties and Wine Varietals

Variety or Varietal

This terminology is mixed up a lot

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Varietal (the Wine) – refers to the grapes that make up the wine

- The wine is made of “**All of a single Variety**”



Varietal

Why do we grow Pinot Noir in N. Coast?

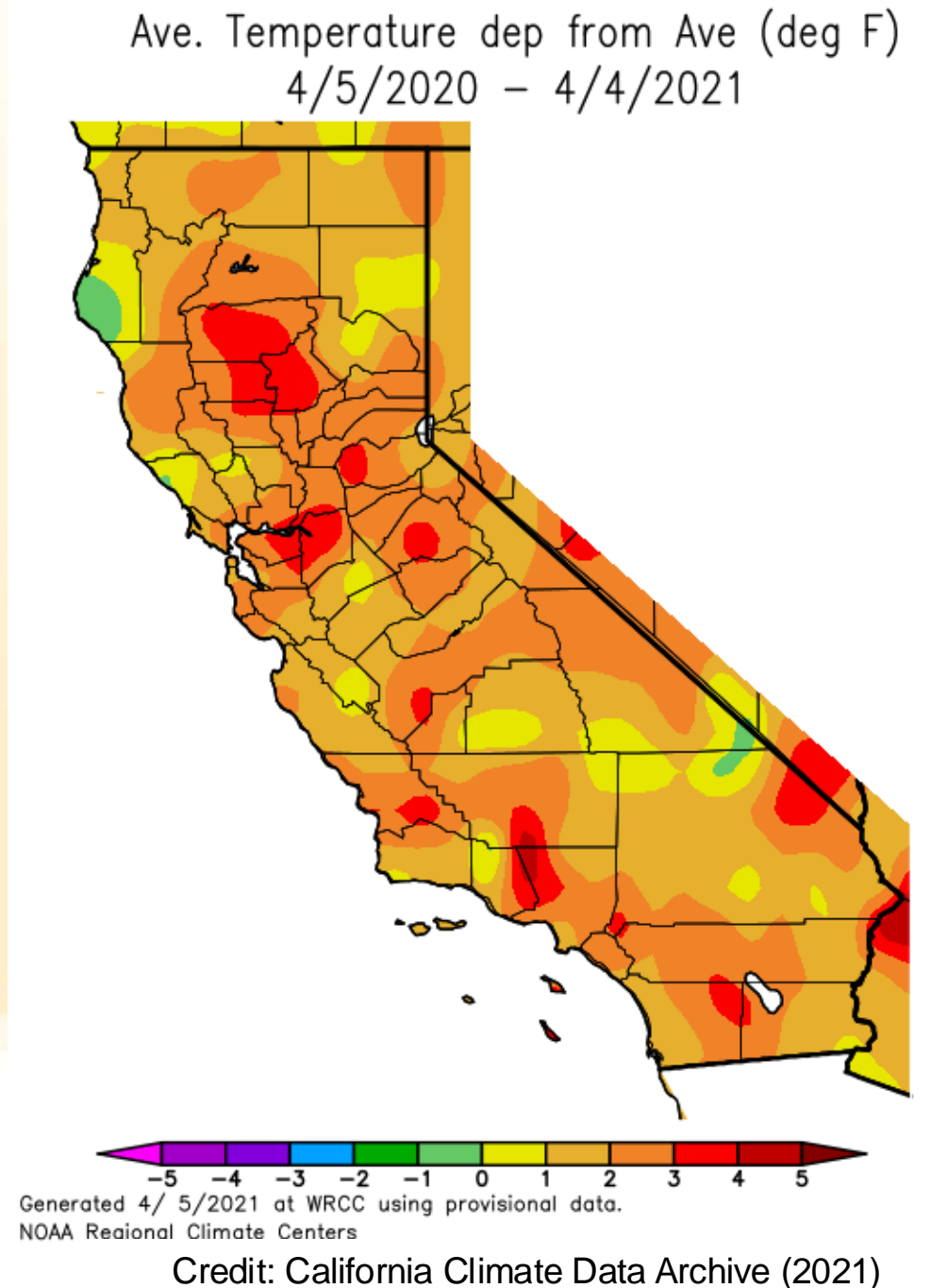
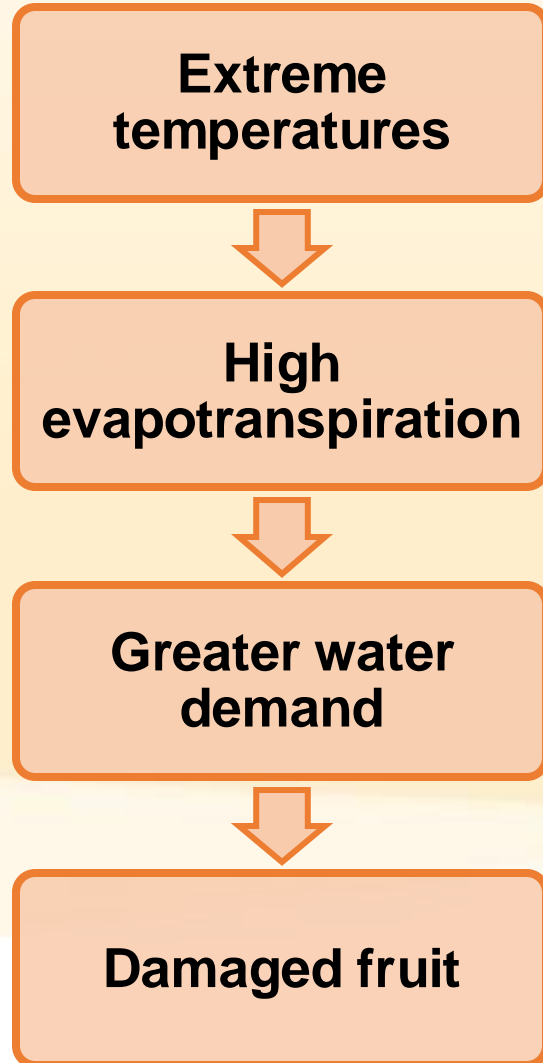
Each grape cultivar is said to make 'better quality' wines in climates they are suited to.

Quality – is **subjective** and usually based on the winemaker's taste

Example:

- Pinot noir is often grown in the North Coast and is considered 'some of the best'.
- Pinot noir can also be grown in Fresno and Lodi, but results in a different phenolic composition than those grown here.

Extreme Heat





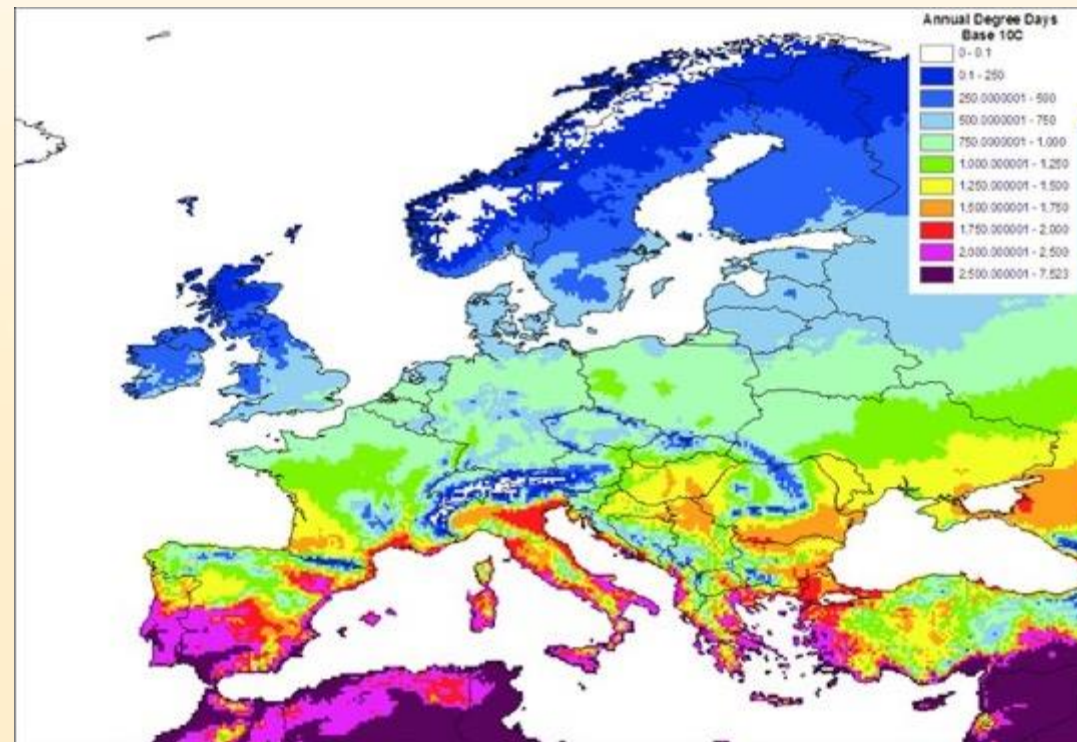
Climatic Origins

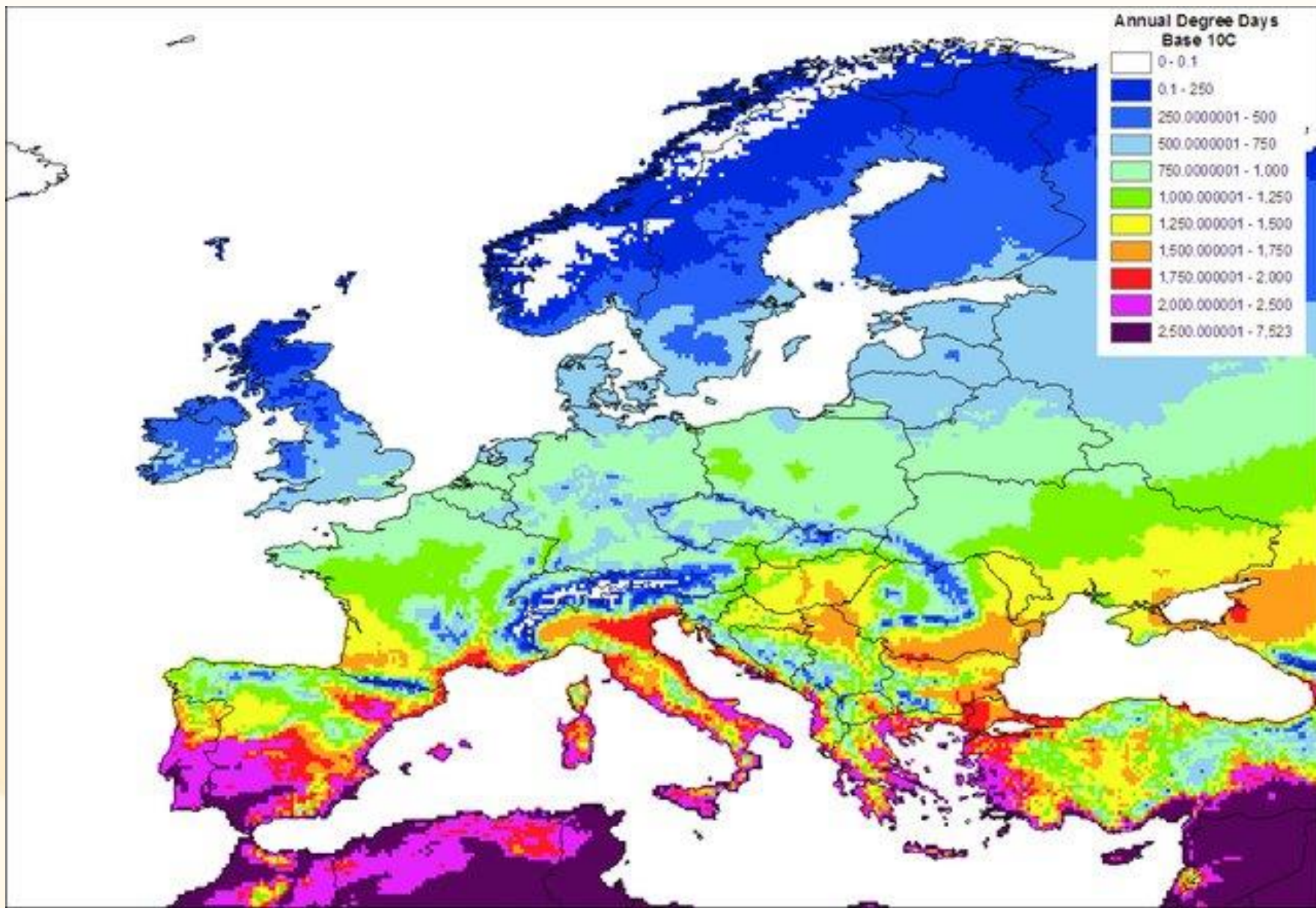
Where did the scions originate from?

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



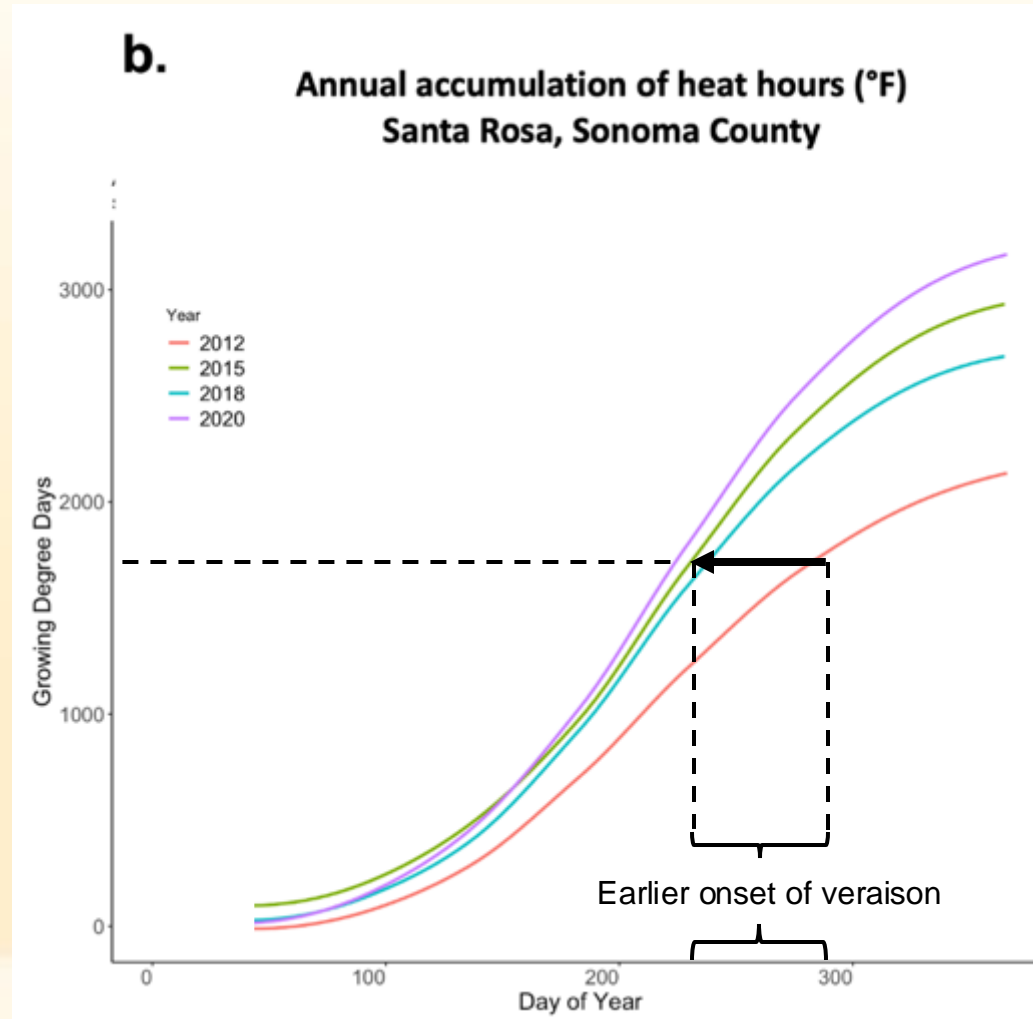


Winkler Index

- A measure of **heat accumulation** over time in a region
- Based on Growing Degree Days
 - GDD calculator available at:
 - <https://ipm.ucanr.edu/weather/degree-days/#gsc.tab=0> (UC ANR IPM)
 - Fahrenheit | lower threshold = 50°F
- Can match it up with original location of each variety to see if it fits in **your 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
Merlot	I, II, III	Cool	High	Moderate
Cabernet franc	I, II, III	Cool	High	Moderate
Malbec/Cot	II, III	Cool-Warm	High	Moderate
Petite Verdot	I, II, III	Cool	Moderate	Low
Zinfandel	II, III, IV, V	Cool-Hot	Moderate	High
Mourvedre	II, III, IV	Warm	High	Moderate
Pinot noir	I, II	Cool	Low	Low
Syrah/Shiraz	II, III, IV, V	Cool-Hot	High	Moderate
Sangiovese	III, IV, V	Warm-Hot	Moderate	High
Petite Sirah/Durif	II, III	Cool-Warm	Moderate	Moderate
Valdiguie/Napa Gamay	III	Warm	Low	High
Carignane	III, IV	Warm-Hot	High	High
Grenache	III, IV	Warm-Hot	High	High
Tempranillo	II, III, IV	Warm	High	High
Barbera	III, IV	Warm-Hot	Moderate	Moderate
Ruby Cabernet	III, IV	Warm-Hot	Moderate	Moderate
Carnelian	IV, V	Hot	High	High
Mission	IV, V	Hot	High	High
Rubired	IV, V	Hot	High	High
Alicante Bouschet	IV, V	Hot	High	High

Shifting Phenology



Cumulative heat accumulation in Santa Rosa, California in 2012, 2015, 2018, and 2020; linear model. (Data from <https://cimis.water.ca.gov>)



Changes in Phenological Timing

In Central Europe the impact of warming climates has been documented in Bernáth et al. 2022 (pre-print)

Between 1985 and 2018

- Budbreak: 5-7 days earlier
- Flowering: 7-10 days earlier
- Berry maturity: 18 days earlier
- Harvest: 8-10 days earlier

Rootstocks of Grapevines

Rootstocks

Rootstocks are used widely in many perennial and annual crops

Act as a buffer between the crop producing tissue and the soil

Protects against soil-borne pests and pathogens and abiotic stress

Introduced to viticulture due to Grapevine Phylloxera



Rootstocks

Can be a 'wild' species that is compatible with the crop scion

Can be a 'developed' or 'cultivated' variety

Scions (i.e., *V. vinifera*) are grafted to the rootstock

If properly done, the rootstock will serve as the root system and not grow any shoots or fruit of its own.

- Similar to a surrogate for pregnancy

Species for Rootstocks

Hundreds of 'wild' grapes that are considered *Rootstock material*

Most rootstocks are offspring of the 'BIG 3'

1. *Vitis rupestris* – St. George
2. *Vitis riparia* – Gloire
3. *Vitis berlandieri* – (doesn't have a fancy name)

Vitis riparia ('Gloire')

Found from the Rocky Mountains to Atlantic Coast (Canada to Texas)

Discovered in **riparian habitats** (next to rivers/streams)

Prefers **alluvial soils** or soils that evolved from flood events

First used in French hybrids of wild grapes x *V. vinifera*



Vitis rupestris ('St. George')

Found between Texas and Tennessee

Discovered in **riparian habitats**
(rocky, dry creek beds)

- This is a different soil type than those where *V. riparia* is found

Prefers **rocky/gravelly soils** or soils with plenty of dry periods

First used by-itself as 'St. George'



Vitis berlandieri

Found in the mountains of Texas

Discovered in **dry, limestone soils**

Prefers **dry soils high in Calcium**

First used in French hybrids, similar to *V. riparia*





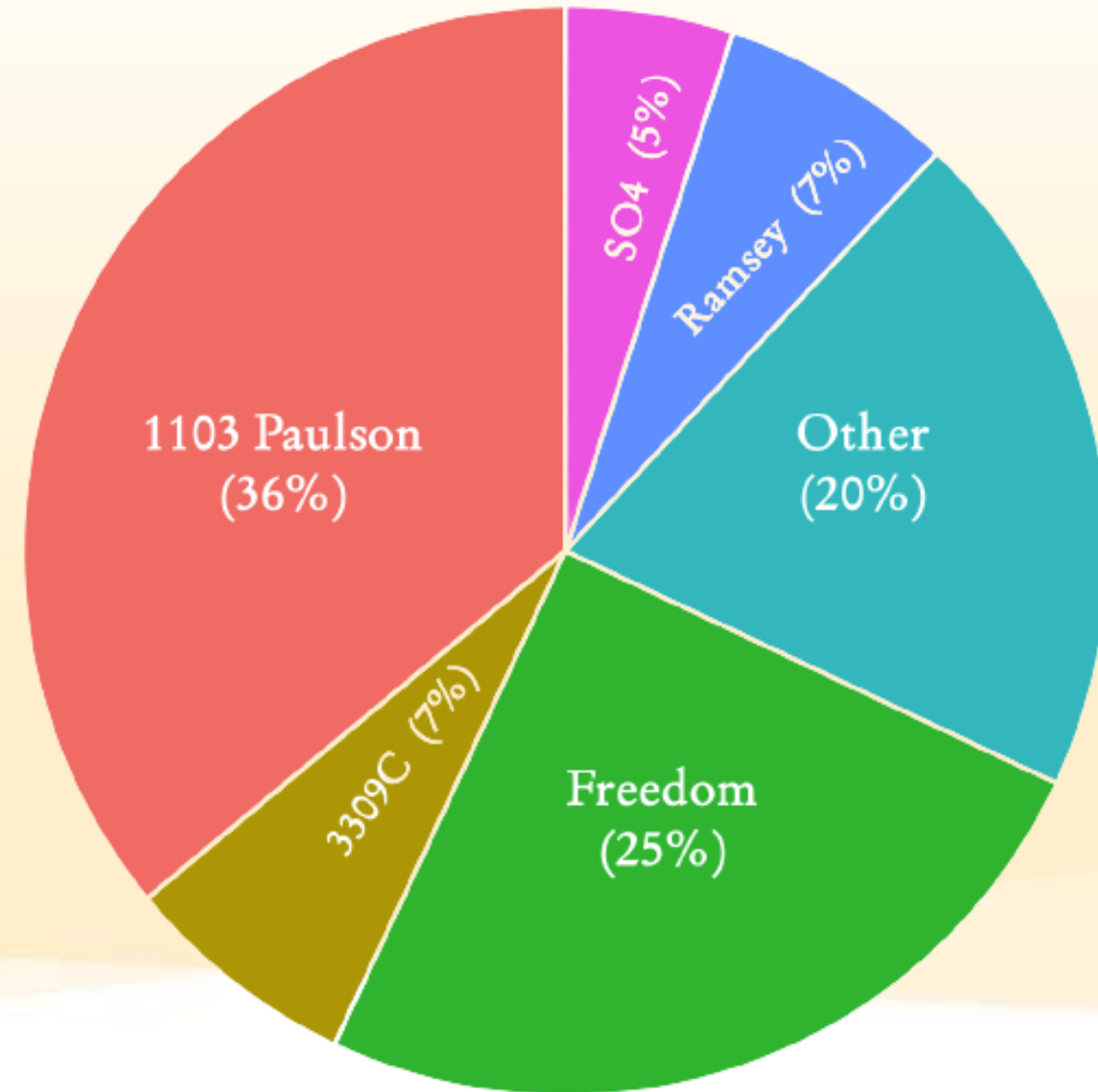
*Image Credit:
Sunridge Nursery*

*“As a vineyard manager your goal isn’t to pick the right rootstock,
It’s to **avoid picking the wrong rootstock.**”*

- Andy Walker

Limited Rootstocks

- The trend observed in scions appears to hold true for rootstock varieties as well
- Data is sparse for rootstocks
- In 2022, we identified the most planted rootstocks across California

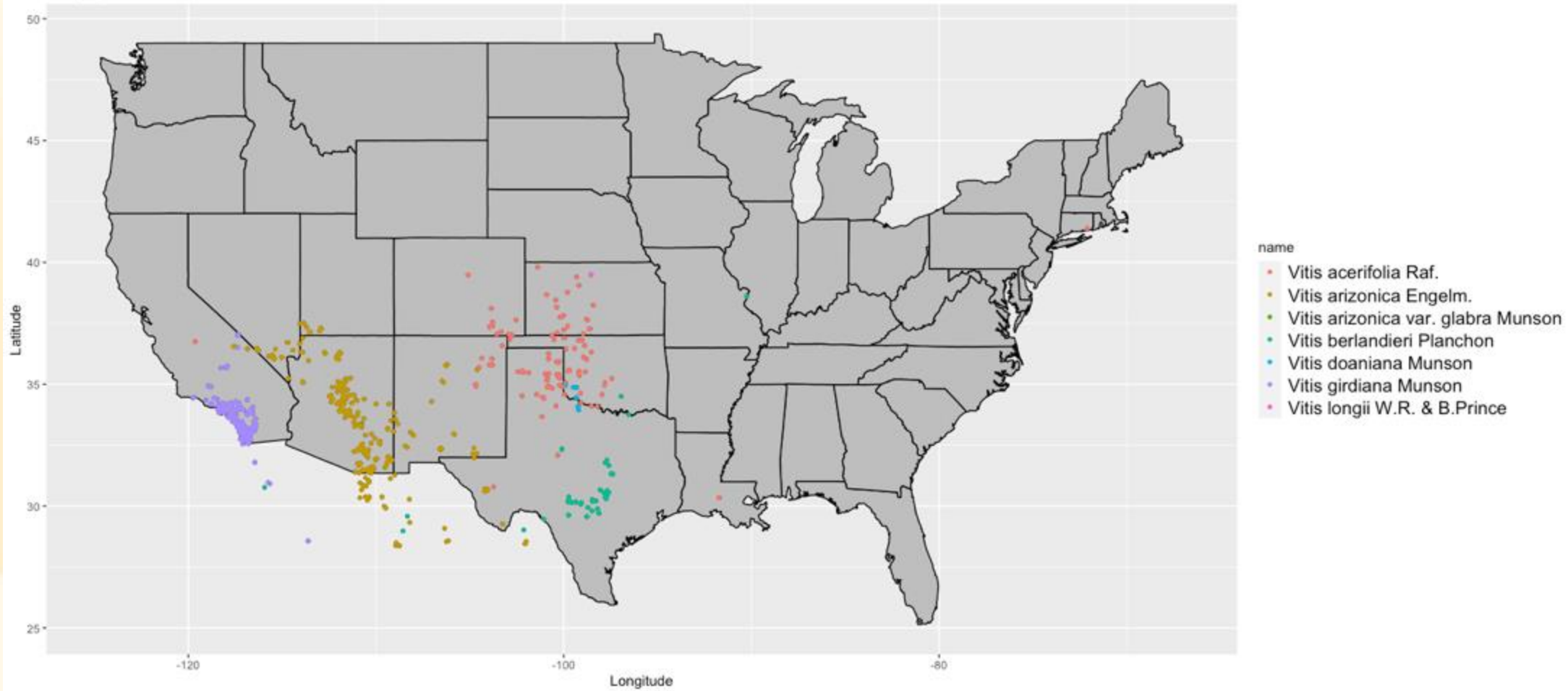


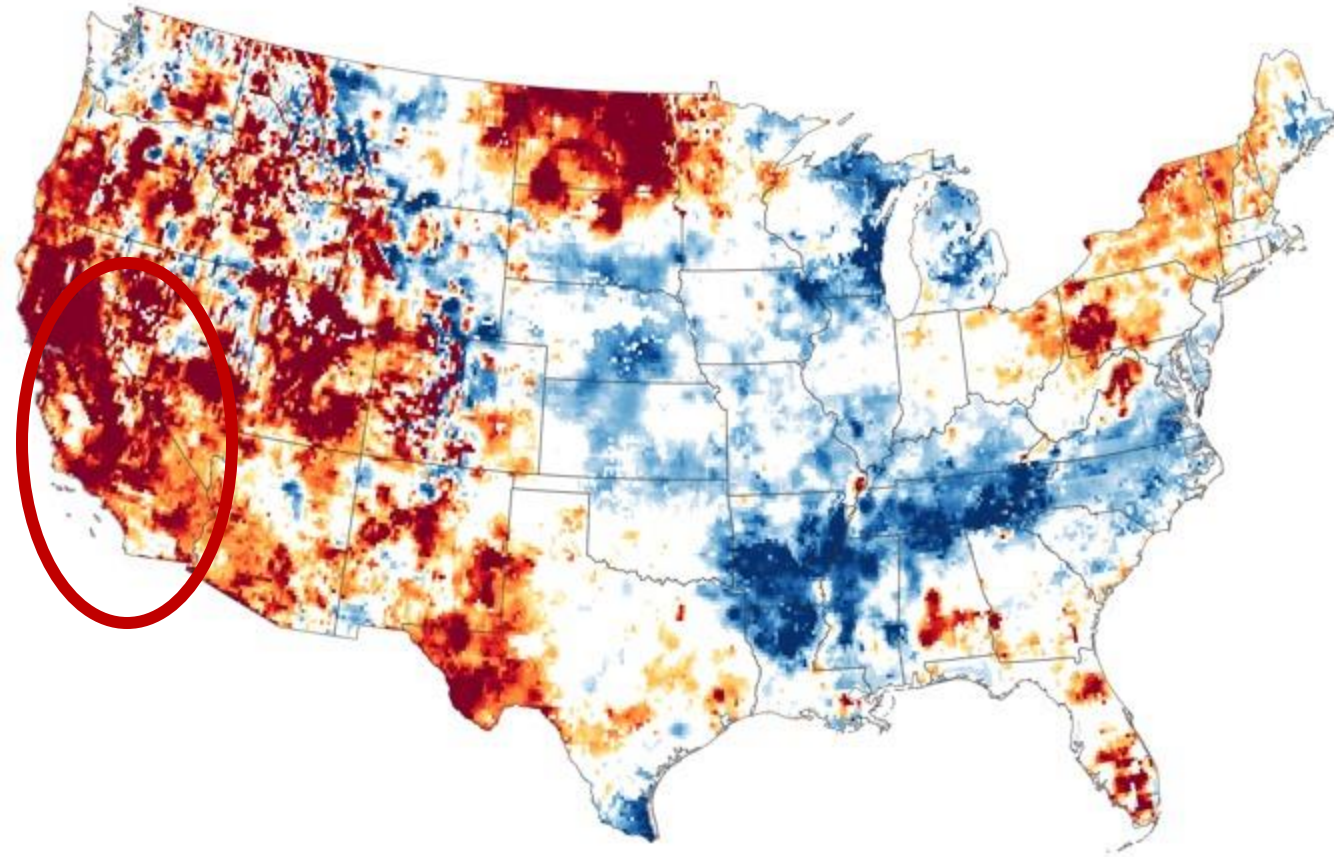
Most Popular Rootstocks in California

2022 (year)

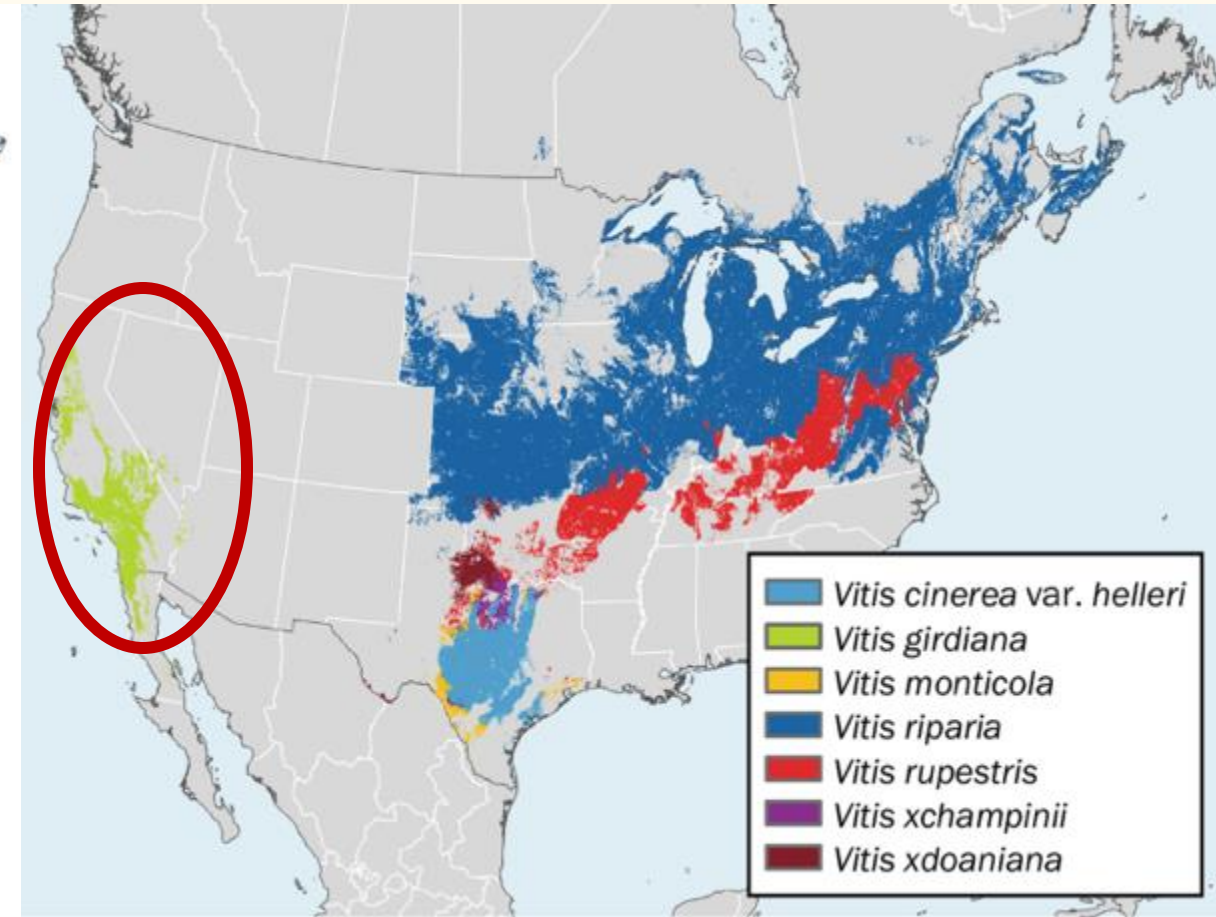
1. **1103 Paulson** (*Vitis rupestris X Vitis berlandieri*)
2. **Salt Creek/Ramsey** (more than two parents)
3. **Freedom** (more than two parents)
4. **3309 C** (*Vitis riparia X Vitis rupestris*)
5. **SO4** (*Vitis riparia X Vitis berlandieri*)
6. **110 Richter** (*Vitis rupestris X Vitis berlandieri*)

Geographic distributions of collected accessions in the United States





Drought conditions – 2021 (NASA)



Heinitz et al. 2019

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

Drought

Drought tolerant rootstocks

Desired characteristics:

- Vigorous
- Deep rooting
- Good root development

Examples:

- 140 Ruggeri
- Ramsey (Salt Creek)
- St. George



140 Ru



140 Ru – deep rooted

101-14 mgt



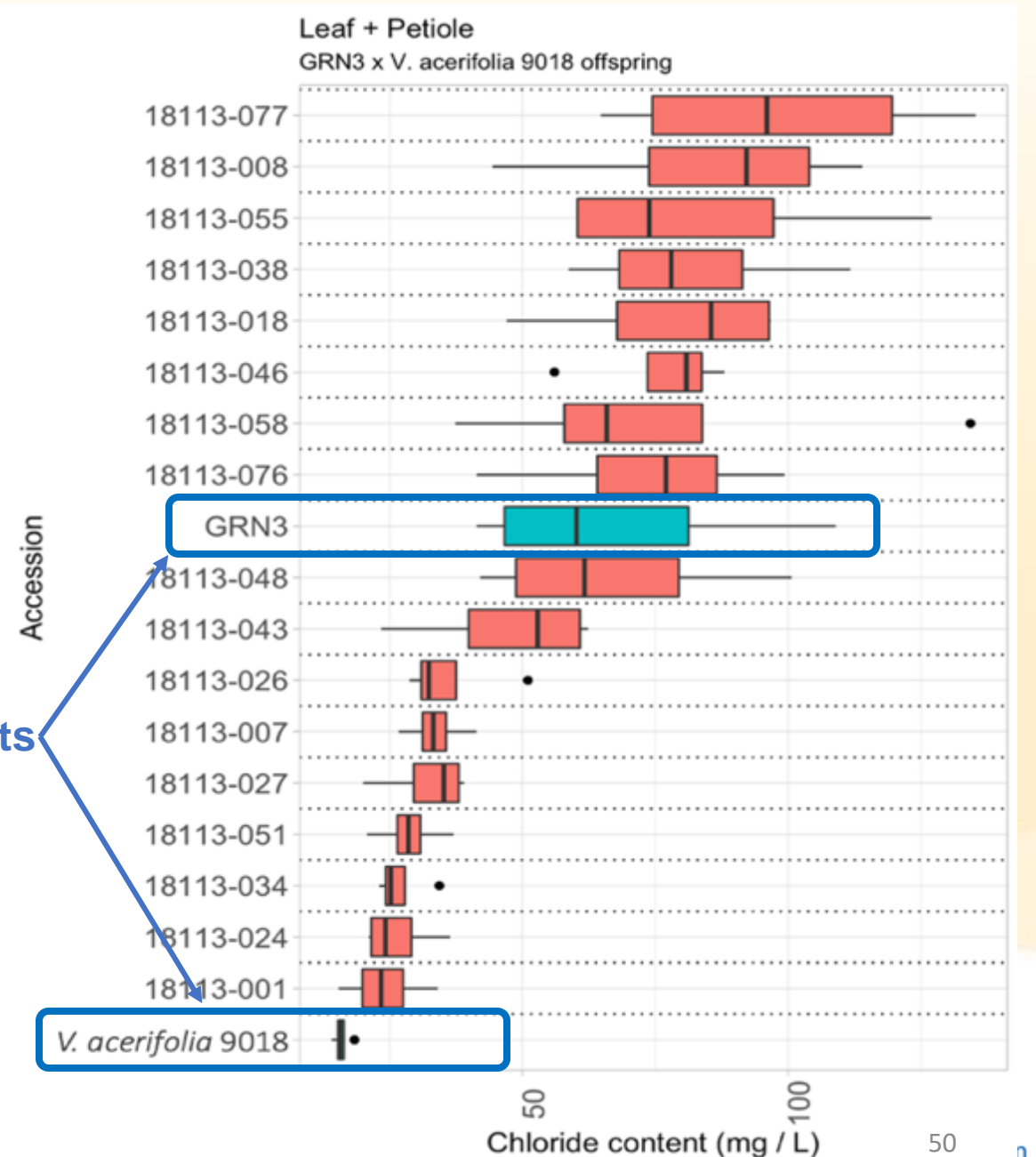
101-14 mgt – shallow rooted

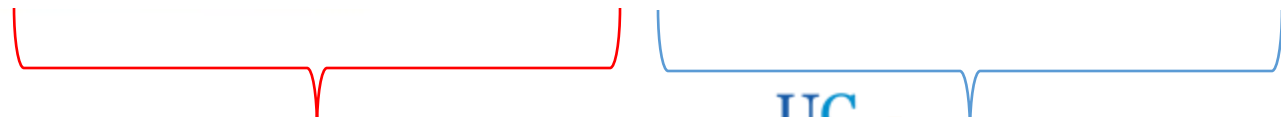
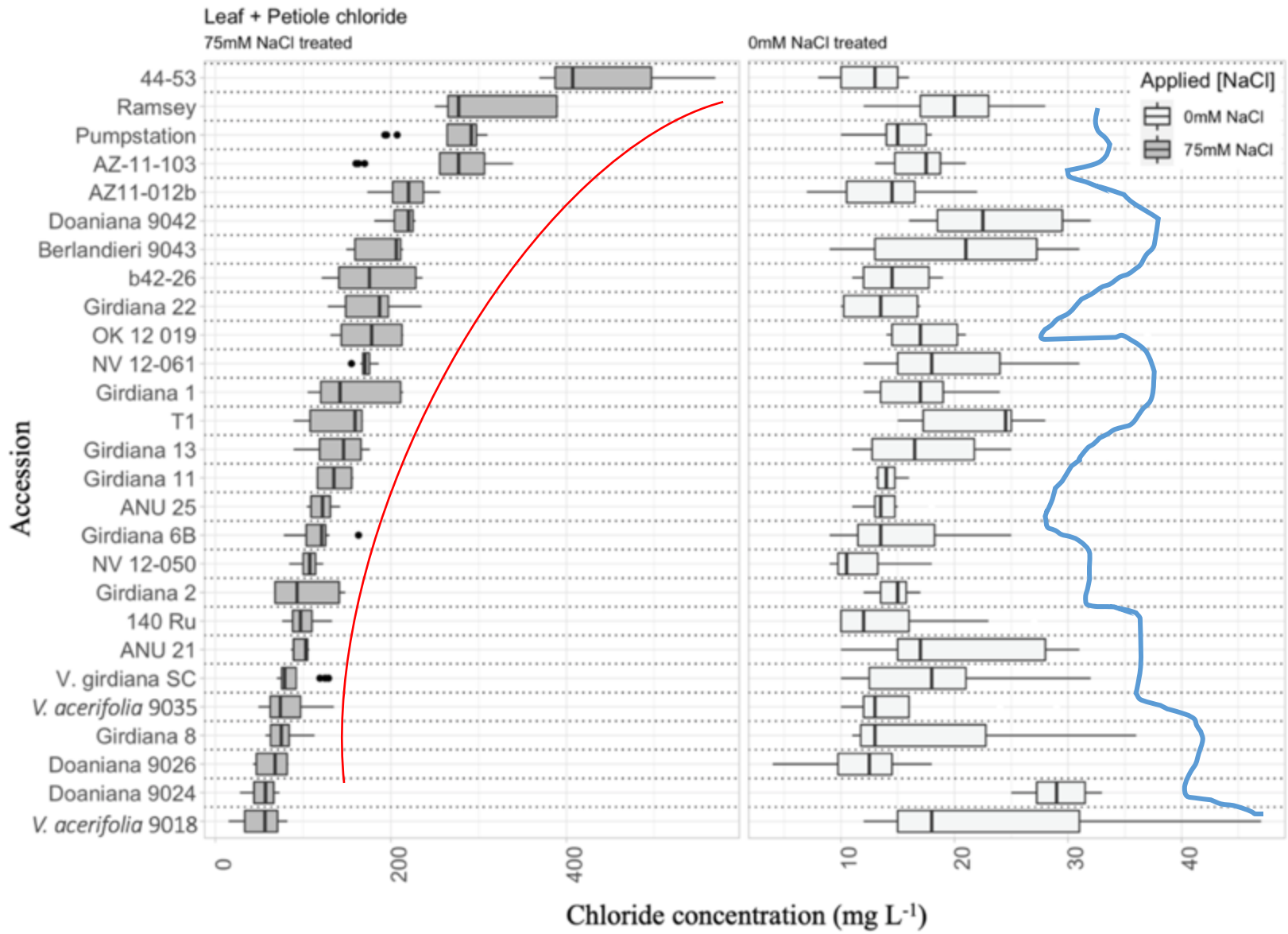
Salinity

Breeding new cultivars

- Long term solution
 - Can take decades
- Utilize wild grapevines
 - Huge gene pool
 - Potential for high salinity tolerance
 - Largely unexplored
- “Breed in” existing traits
 - Preserve other traits of existing rootstocks
 - Rootability, drought tolerance, vigor

Parents





Difference in scale



Rootstock	Parents	Rooting & Graftability	Scion Vigor	Dagger Nematode	Root Knot Nematode	Ring Nematode	Citrus Nematode	Lesion Nematode
UCD GRN-1	<i>V. rupestris</i> <i>M. rotundifolia</i>	Moderate	Moderate	✓	✓	✓	✓	~
UCD GRN-2	<i>V. rufotomentosa</i> <i>V. champinii</i>	Good	High	✓	✓	X	X	~
UCD GRN-3	<i>V. rufotomentosa</i> <i>V. champinii</i> <i>V. monticola</i>	Good	High	✓	✓	~	~	~
UCD GRN-4	<i>V. rufotomentosa</i> <i>V. champinii</i> <i>V. monticola</i>	Good	Moderate to High	✓	✓	~	~	~
UCD GRN-5	<i>V. champinii</i> <i>V. berlandieri</i> <i>V. riparia</i>	Moderate to Poor	Low to Moderate	✓	✓	✓	~	✓

- ✓ = Resistant
- ~ = Moderately Resistant
- X = Moderately Susceptible or Susceptible

The Future Vineyard

New Climate New Cultivars

- Northern California is still a cold-climate, viticulture region
- Many other viticultural areas will need to adapt soon
- Varieties that can tolerate drought and heat will be essential in the future



Localized Climate Shifts

- Impacts of climate change are hyper-local
- Each AVA will have to try new varieties and techniques until they find what works
- Research and participation can make this easier





Selecting Cultivars for the Future

1. Breeding and genetic solutions (GRN rootstocks; PD-resistant scions)
2. Trying out new scion and rootstock cultivars in your region
3. When choosing a new cultivar, try to match the original climate of where it was bred with your expected future climate conditions

Supporting Research

Participate in UC Cooperative Extension

- Tell UC Cooperative Extension Advisors what research you want to see be pursued
 - We are here to address grower-facing problems
 - Our job is to listen to what our clientele needs and pursue answers
- Attend events we organize
 - This is how we make new research accessible
 - Provides an opportunity to have face-to-face conversations
- Ask us for resources
 - We will create them if we don't already have them prepared for public use



Downloadable Presentation

- You can find this presentation at:
 1. <https://ucanr.edu/sites/chenlab>
 2. Speaker Presentations



- 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

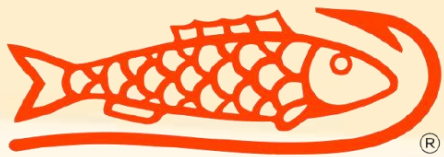
The following articles contributed information to this article. They have been provided as accessible hyperlinks for the reference of readers:

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
Bahco/Snap-On for
providing the tools
for this course



BAHCO



Contact me: codchen@ucanr.edu

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