Cultivars and climates:

Rootstock and mesoclimate impacts on winegrape production in the north coast

Christopher Chen, Ph.D.

UCCE – Integrated Vineyard Systems Advisor

North Coast Viticulture

Sonoma • Mendocino • Lake

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Climate and Cultivars


66.6

Climate Concerns

Must consider both **direct** and **indirect** impacts of changing climates on grapes

1. Change in growing season length
2. Earlier or later budbreak and ripening
3. More extreme/frequent weather events
4. Resource scarcity (i.e., water/fertilizer)
5. Increased soil salinity

Rootstocks by Usage

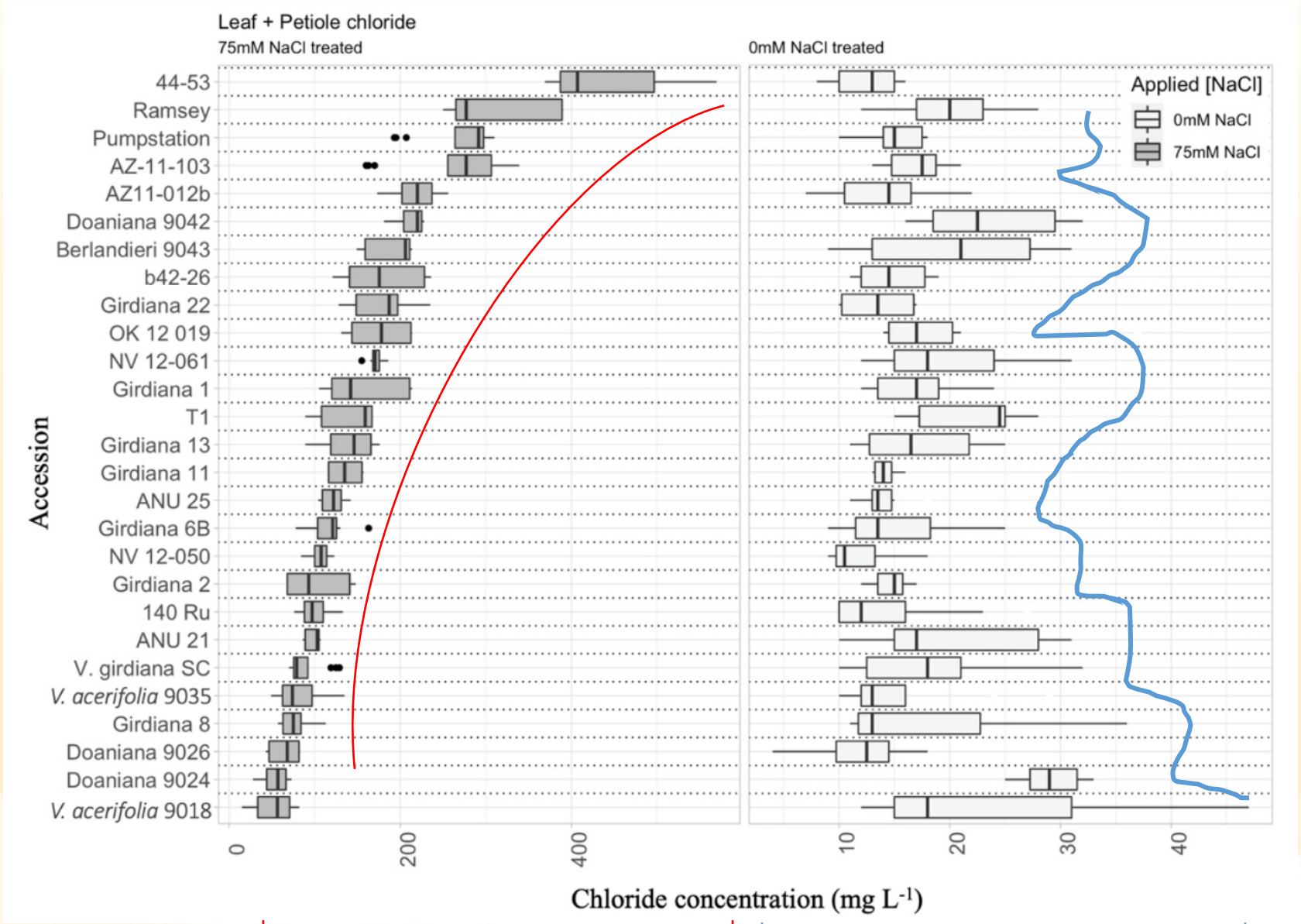
Rootstock	Vitis parentage	Phylloxera resistance	Nematode Resistance		Tolerance			
			Root knot	Dagger (*Xiphinema index*)	Drought	Wet soil	Salinity	Lime
Riparia Gloire	riparia	High	Low	Med.	Low	Low	Med.	Low
St. George (*Rupestris du lot*)	rupestris	High	Low	Low	Low–med. in shallow soils; high in deep soils	Low–med.	Med.–high	Med.
SO4 (Selection Oppenheim)	berlandieri × riparia	High	Med.–high	Low–med.	Low–med.	Med.–high	Low–med.	Med.
5BB (Kober)	berlandieri × riparia	High	Med.–high	Med.	Med.	Low	Med.	Med.–high
5C (Teleki)	berlandieri × riparia	High	Med.–high	Low–med.	Low	Low–med.	Med.	Med.
420A (Millardet et de Grasset)	berlandieri × riparia	High	Med.	Low	Med.	Low–med.	Low	Med.–high
99R (Richter)	berlandieri × rupestris	High	Med.–high	Low–med.	Med.–high	Low	Med.	Med.
110R (Richter)	berlandieri × rupestris	High	Low–med.	Low	High	Low–med.	Med.	Med.

140 Ru

140 Ru – deep rooted

101-14 mgt

101-14 mgt – shallow rooted



Difference in scale

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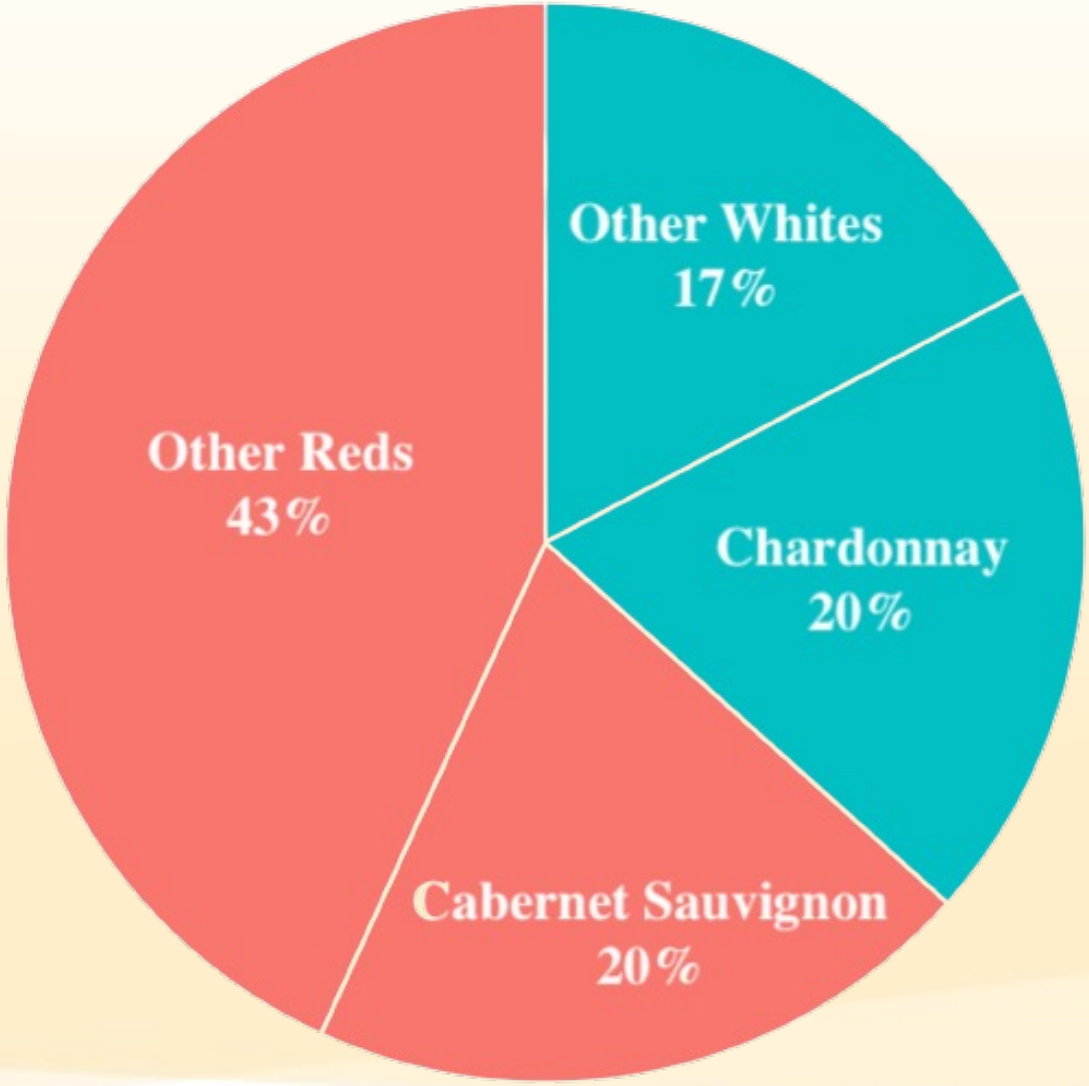
Deploying Diversity

Scion Variety Bottleneck

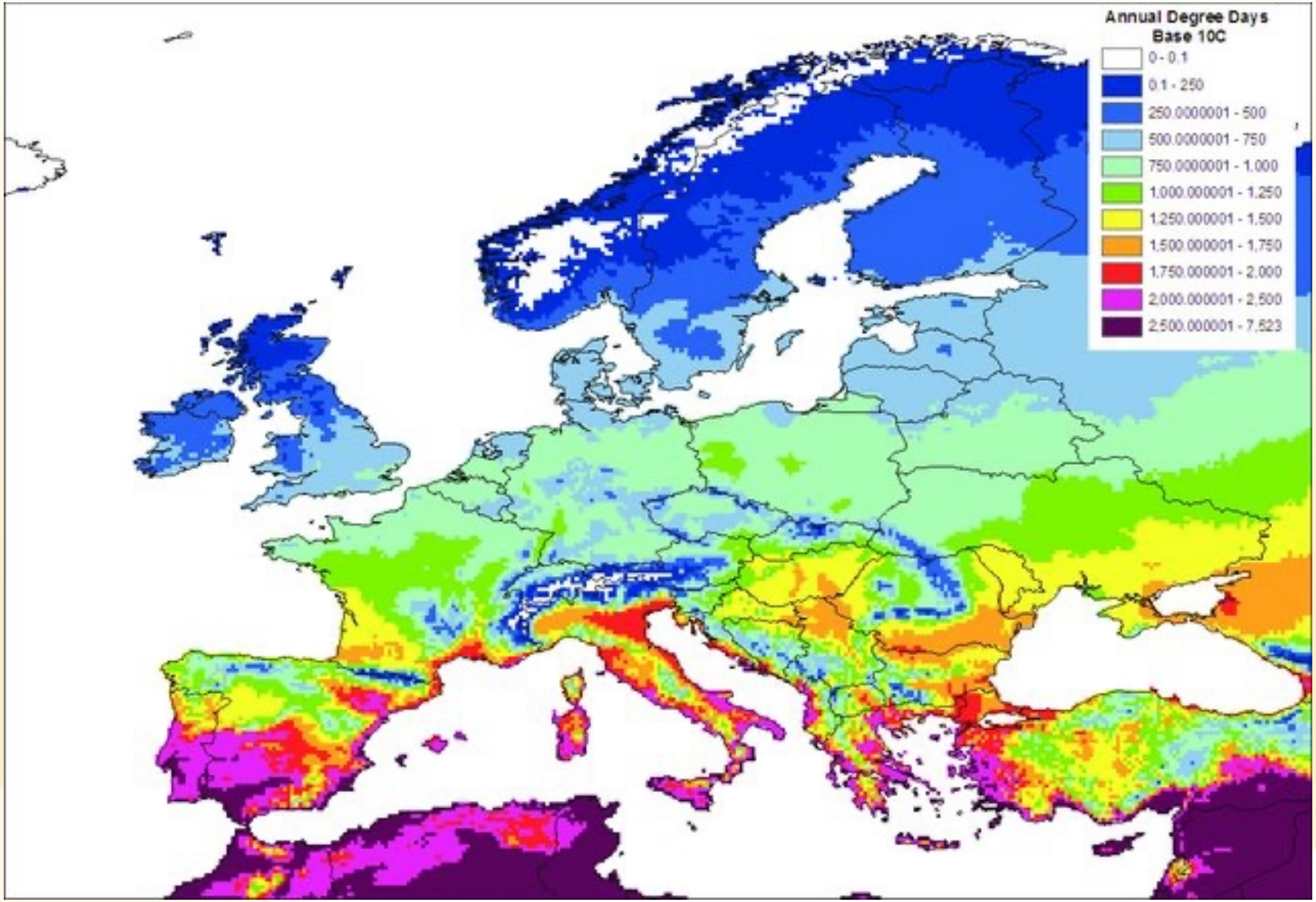
- Market limitations on profitable cultivars
- Bottleneck down to two scions
- Wide range of climate adaptation in scions

Examples of desirable characteristics:

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

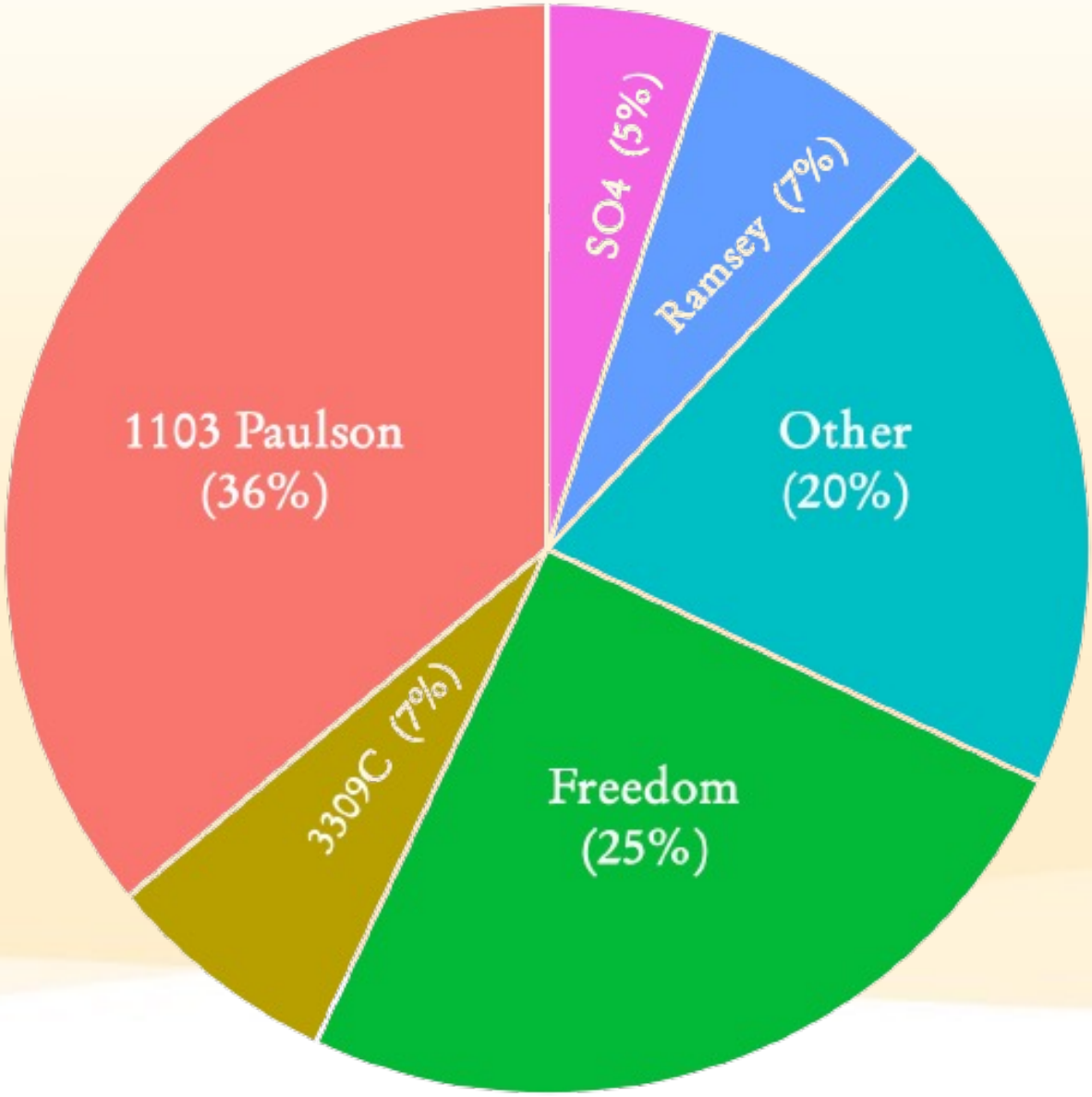


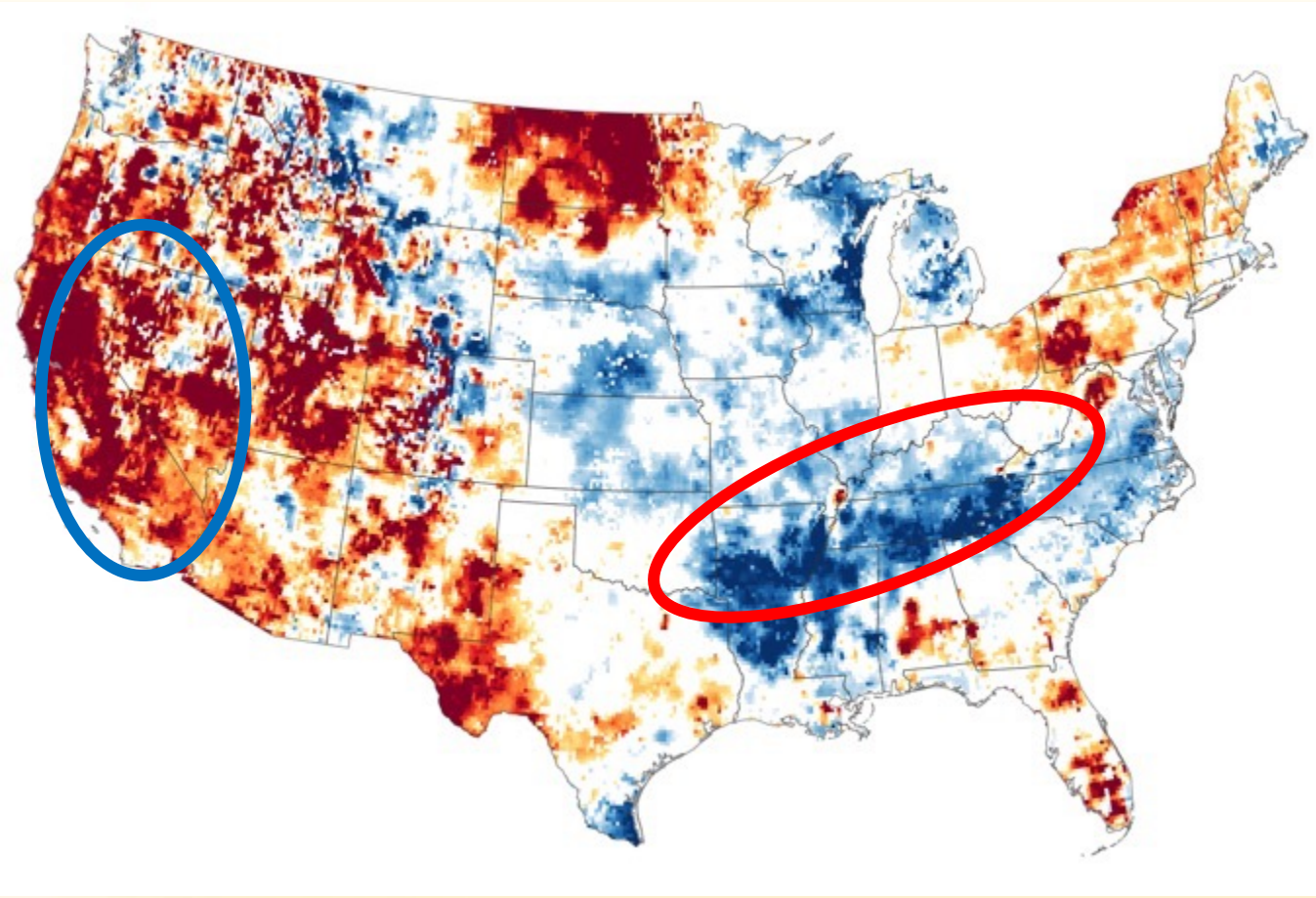
CA Grape Acreage Report (2020)


Annual Degree Days
Base 10C
0 - 0.1
0.1 - 250
250.0000001 - 500
500.0000001 - 750
750.0000001 - 1,000
1,000.000001 - 1,250
1,250.000001 - 1,500
1,500.000001 - 1,750
1,750.000001 - 2,000
2,000.000001 - 2,500
2,500.000001 - 7,523

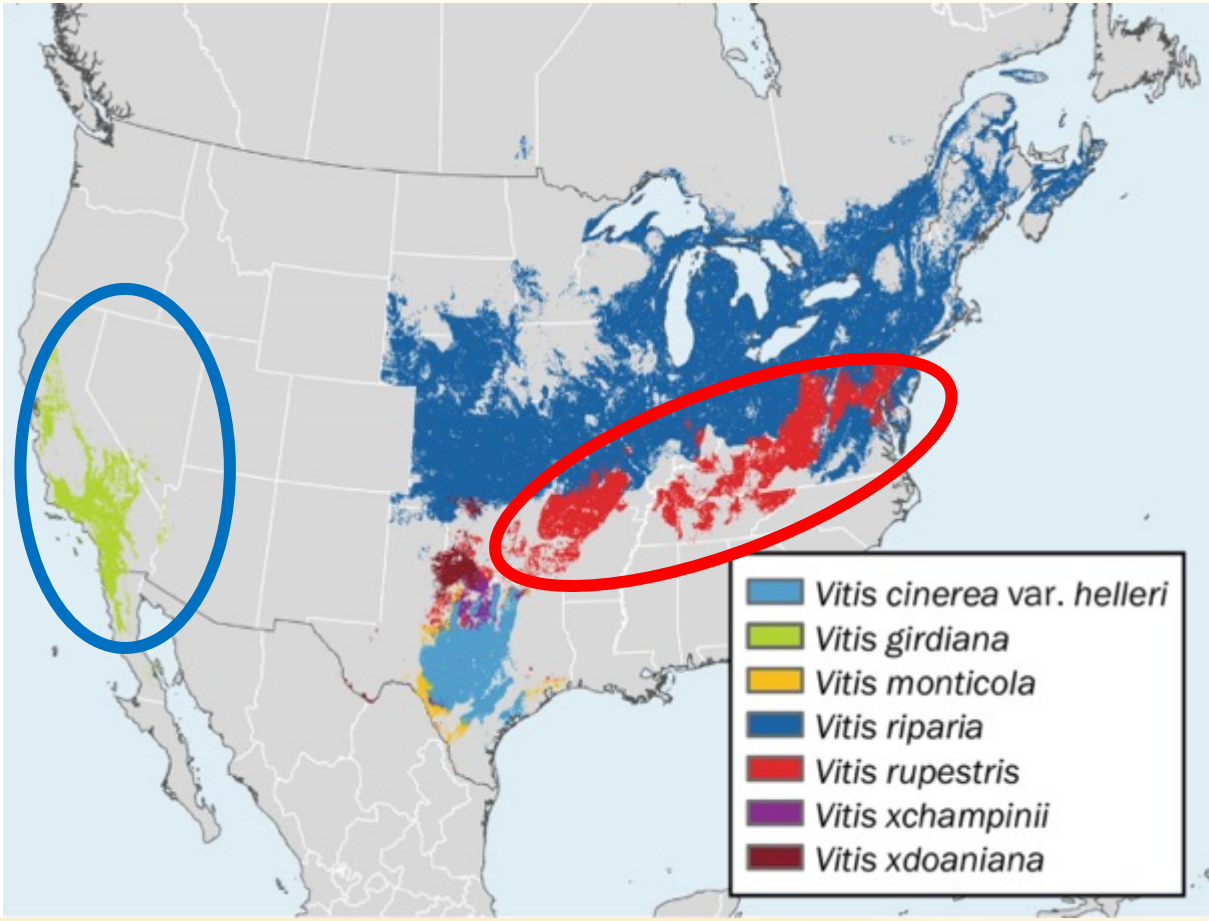
Limited Rootstocks

- 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





Drought conditions – 2021 (NASA)



Heinitz et al. 2019

Tolerant Cultivars

Rootstocks have long been used as a method of tolerance to both biotic and abiotic stressors

- GRN rootstocks for nematode tolerance

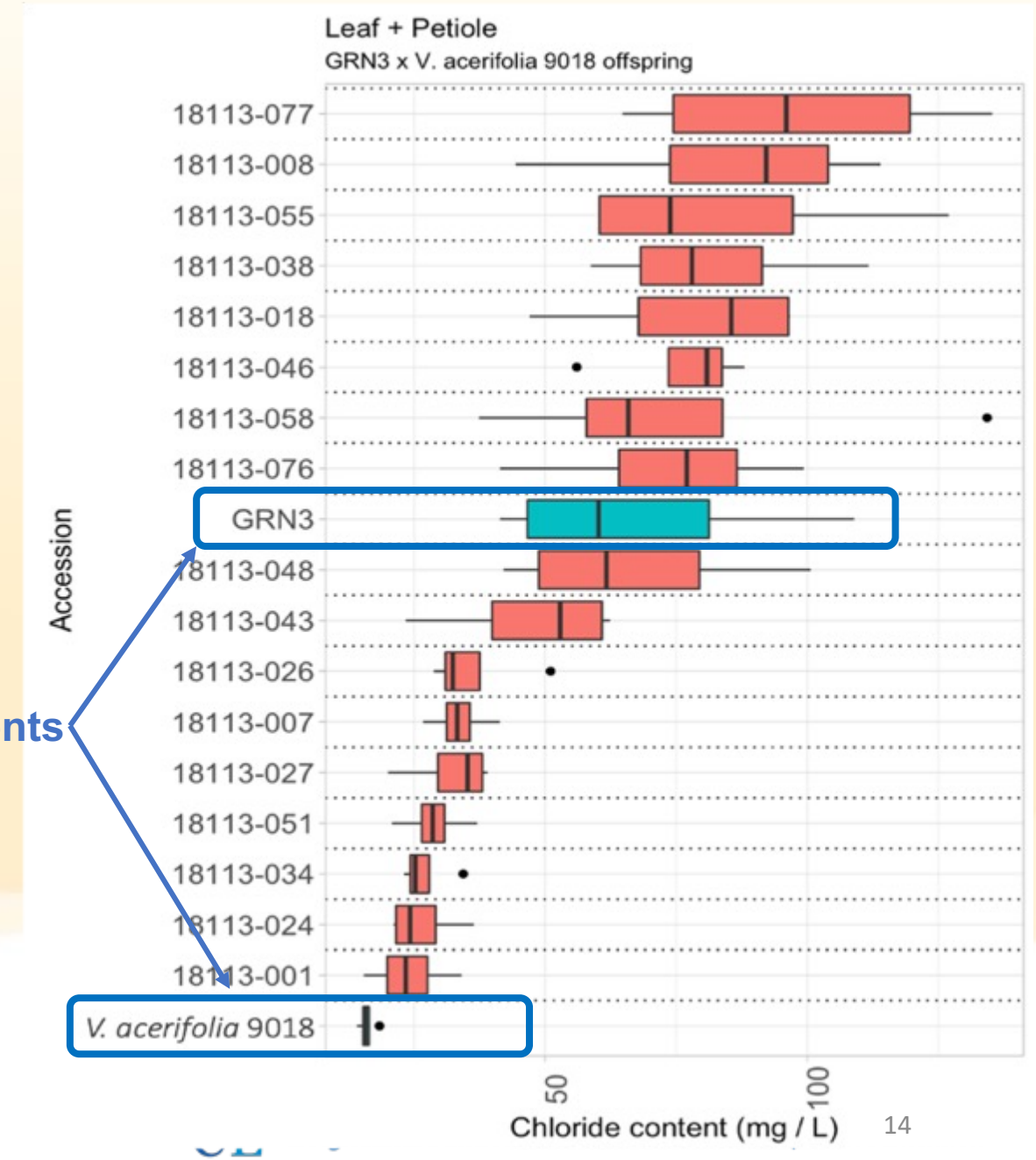
Scions are also being developed to help impart tolerance to specific pests and/or diseases

- Pierce's Disease resistant scions

New Agronomic Traits

Breeding new cultivars

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



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Research

Climate-Adaptive Rootstocks in California's North Coast

Climate-Focused Studies

- UCCE North Coast Viticulture is conducting studies to identify how grapevine selection can reduce the impact of environmental extremes

- Two types of studies:

  1. Describing climate conditions and changes over time
  2. Quantifying effects of rootstock selection on the observed impact of detrimental environmental events on agronomic parameters of winegrapes

Study 1: Light Modification to Reduce Microclimate Temperatures

Shade Netting
(Study conducted in 2017)

No shade netting

Shade netting

a

b

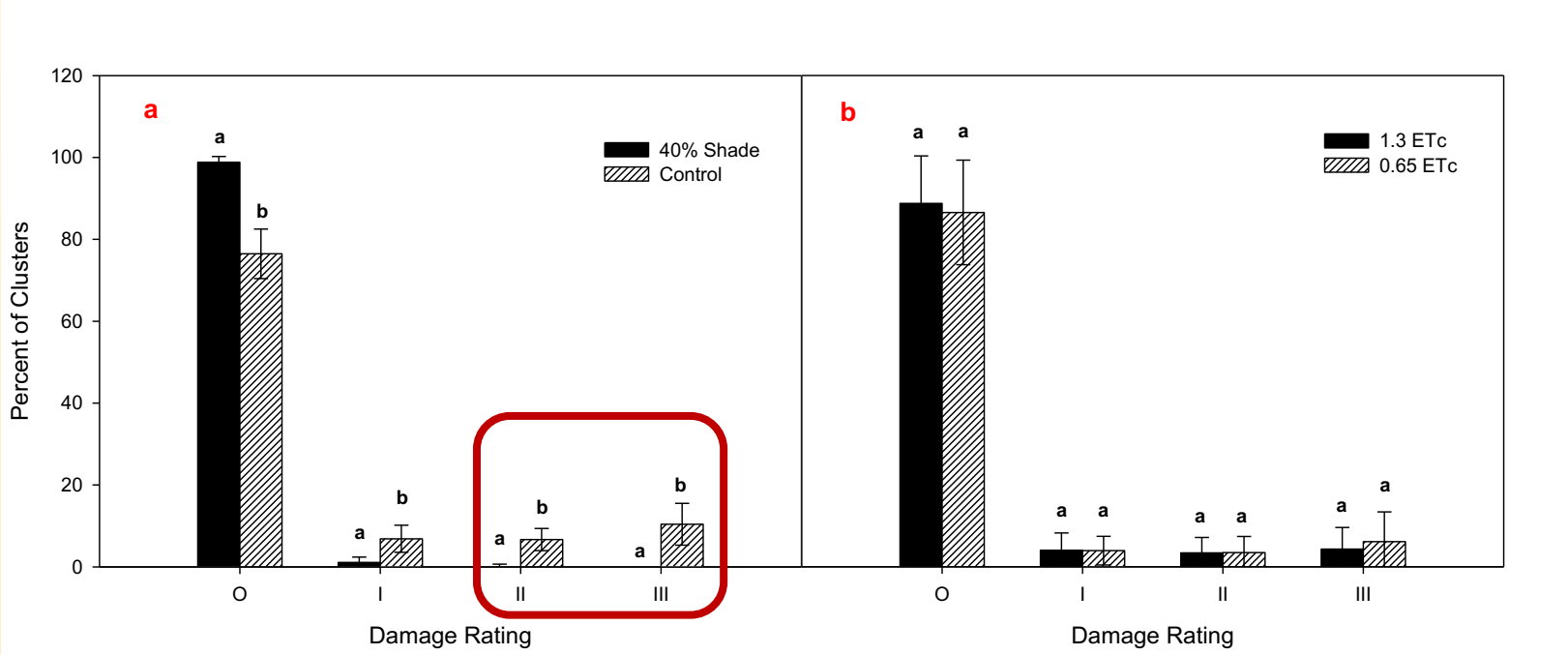
c

Left to Right: (a) no shade net applied; (b) example of black shade net applied following fruit set; (c) resulting cluster protected by shade net; all images were taken on the same day in Oakville, CA in August 2017.

Shade Netting – Visible Damage

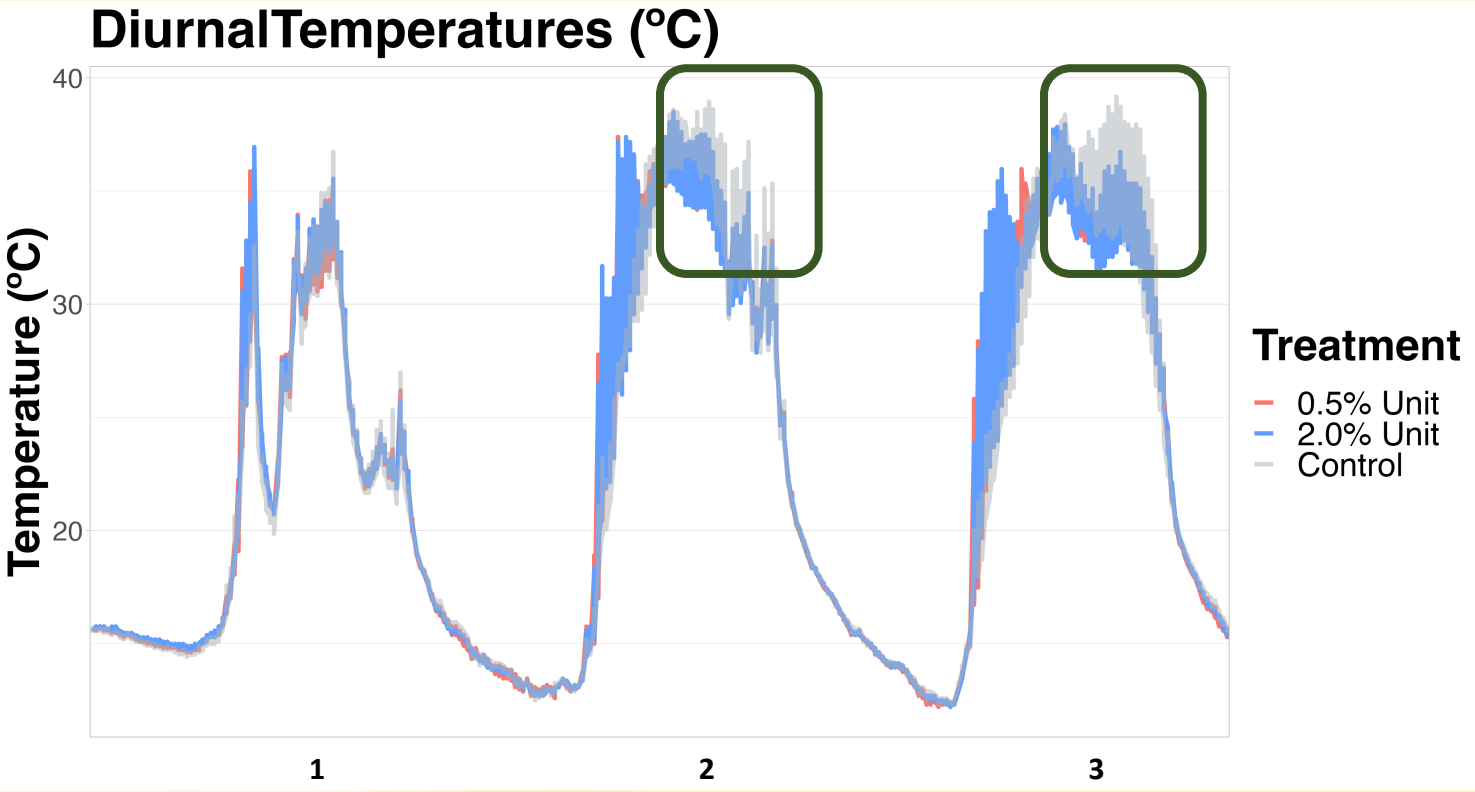
Using a rating system we visually assessed damage to whole clusters attributed to excess exposure:

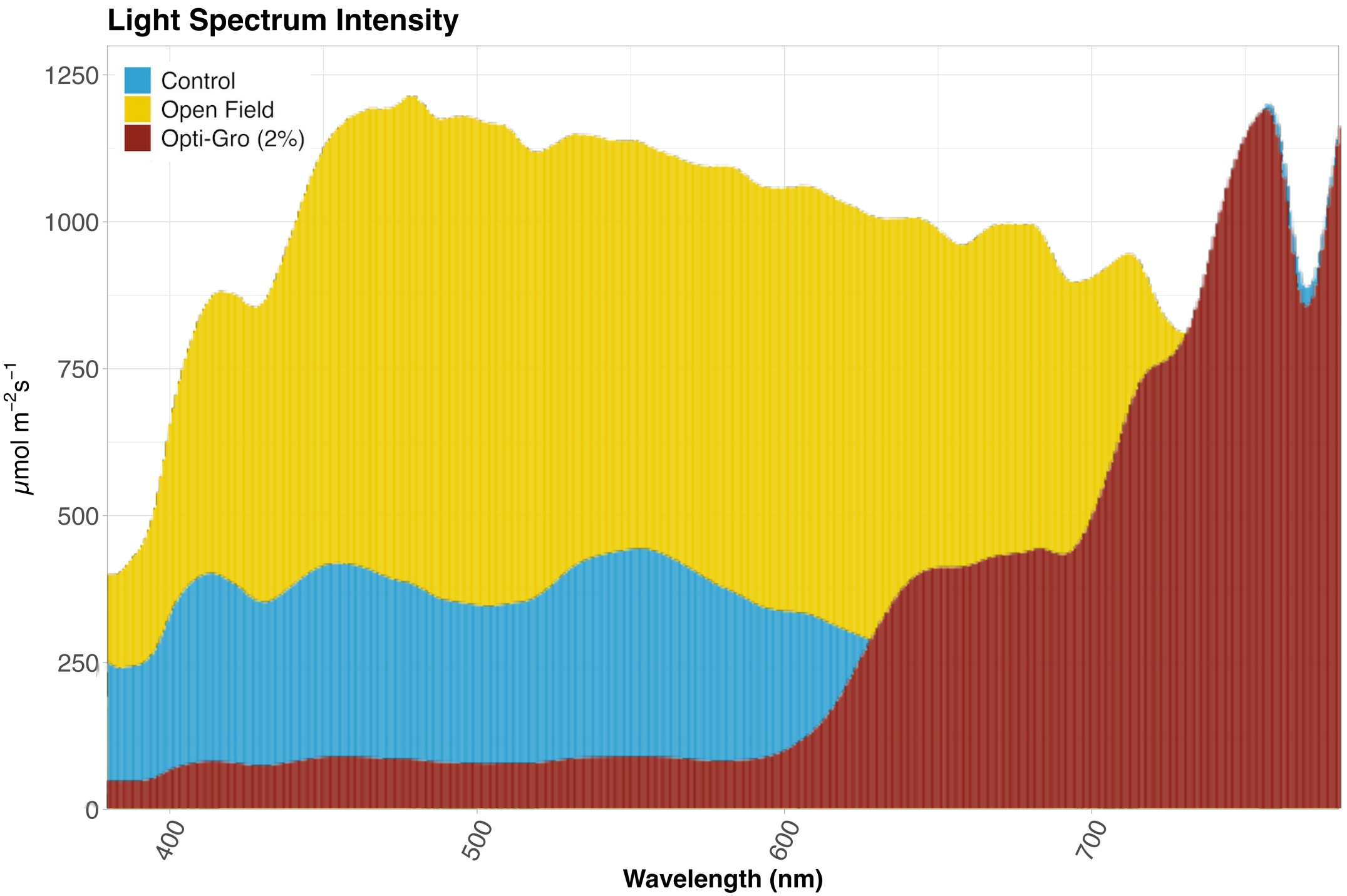
- 0 = No damage
- 1 = Minor damage
- 2 = Moderate damage
- 3 = Extreme damage



Martínez-Lüscher et al. (2020)

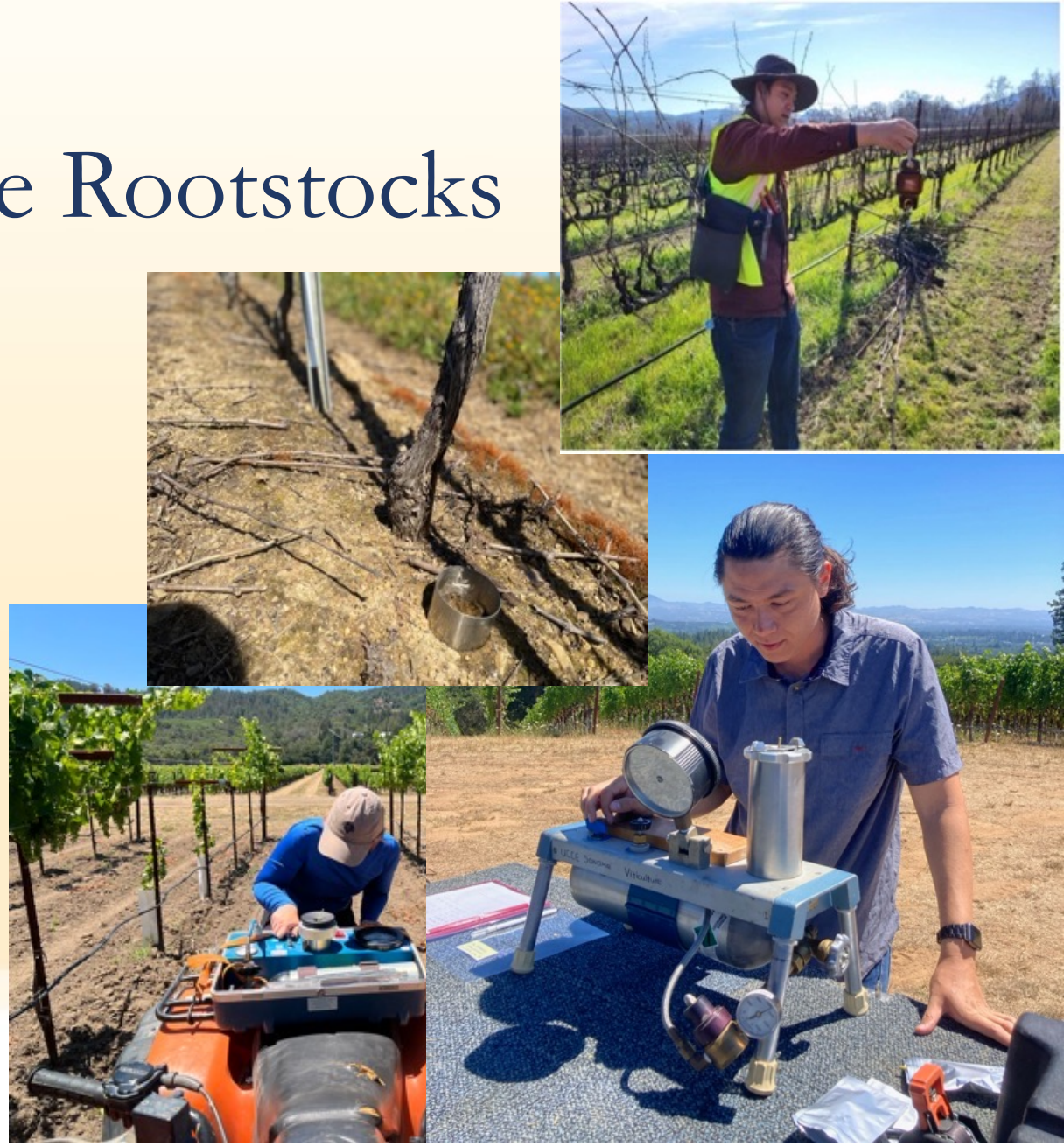
Study 1: Light Modification – Impacts on Young Vine Establishment




Light Spectrum Intensity
Control
Open Field
Opti-Gro (2%)
1250
1000
750
500
250
0
µmol m-2s-1
400
500
600
700
Wavelength (nm)

Study 2: Climate-Adaptive Rootstocks

- Conducted 2022-2023
- Two Scions
  1. Cabernet Sauvignon
  2. Chardonnay
- Five Rootstocks
  - Most common rootstocks sold in past five years
- Nine locations
- Three Mesoclimate Classifications

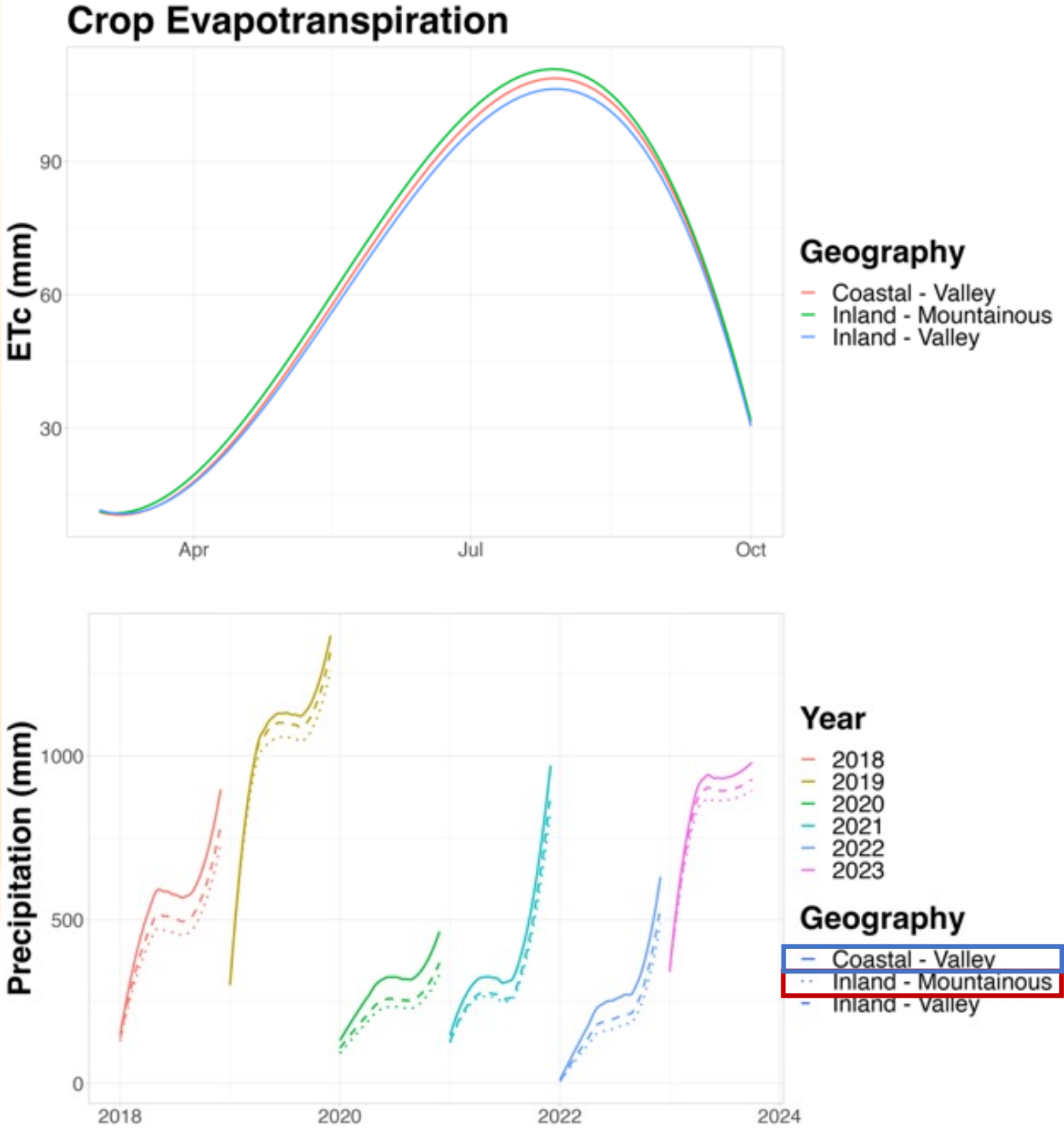


Mesoclimate Classification

- Three classifications
  1. Coastal Valley
  2. Inland Valley
  3. Inland Mountainous
- Based on
  1. Proximity to coast
  2. Average temperatures
  3. Precipitation
  4. Geographic Location

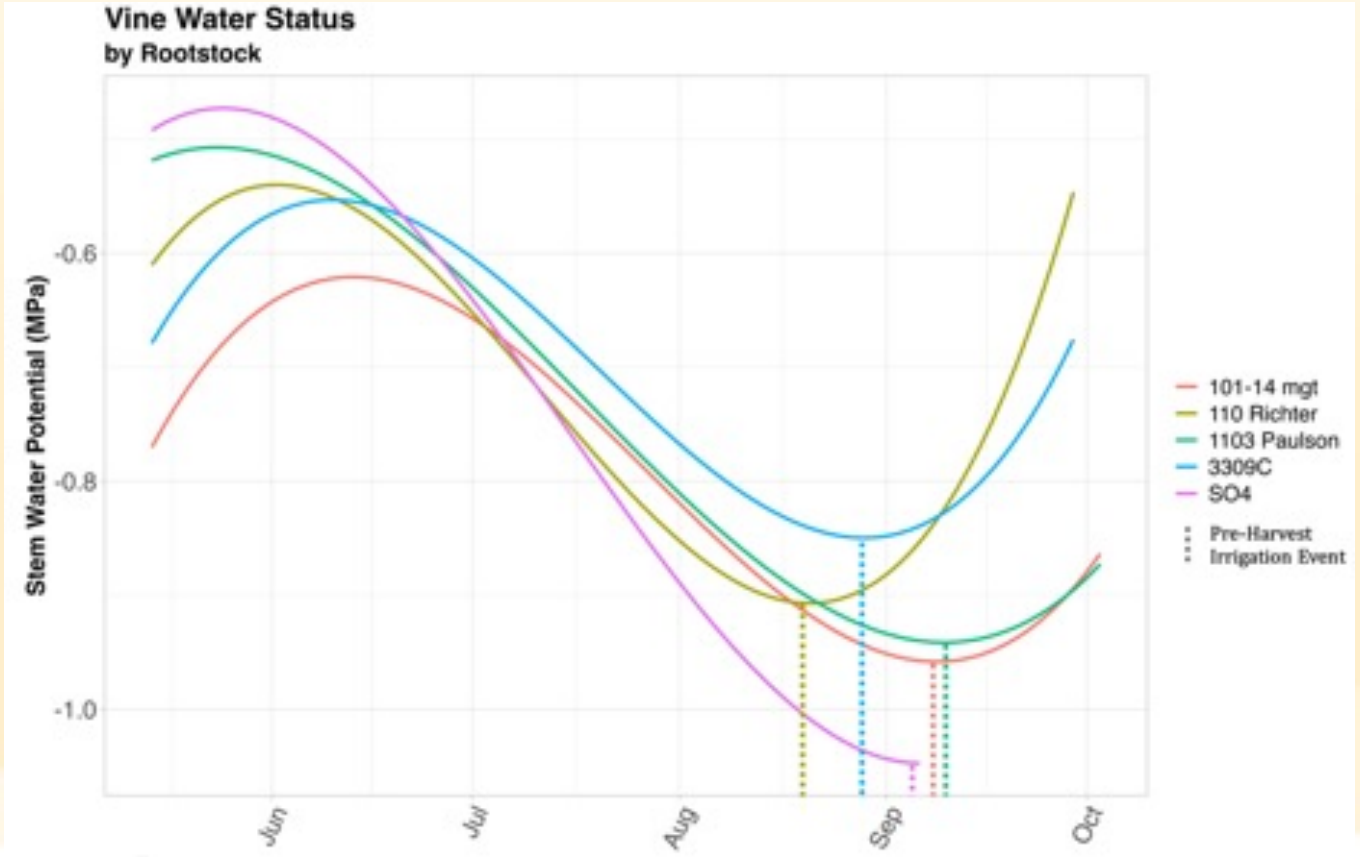
Water Use by Mesoclimate

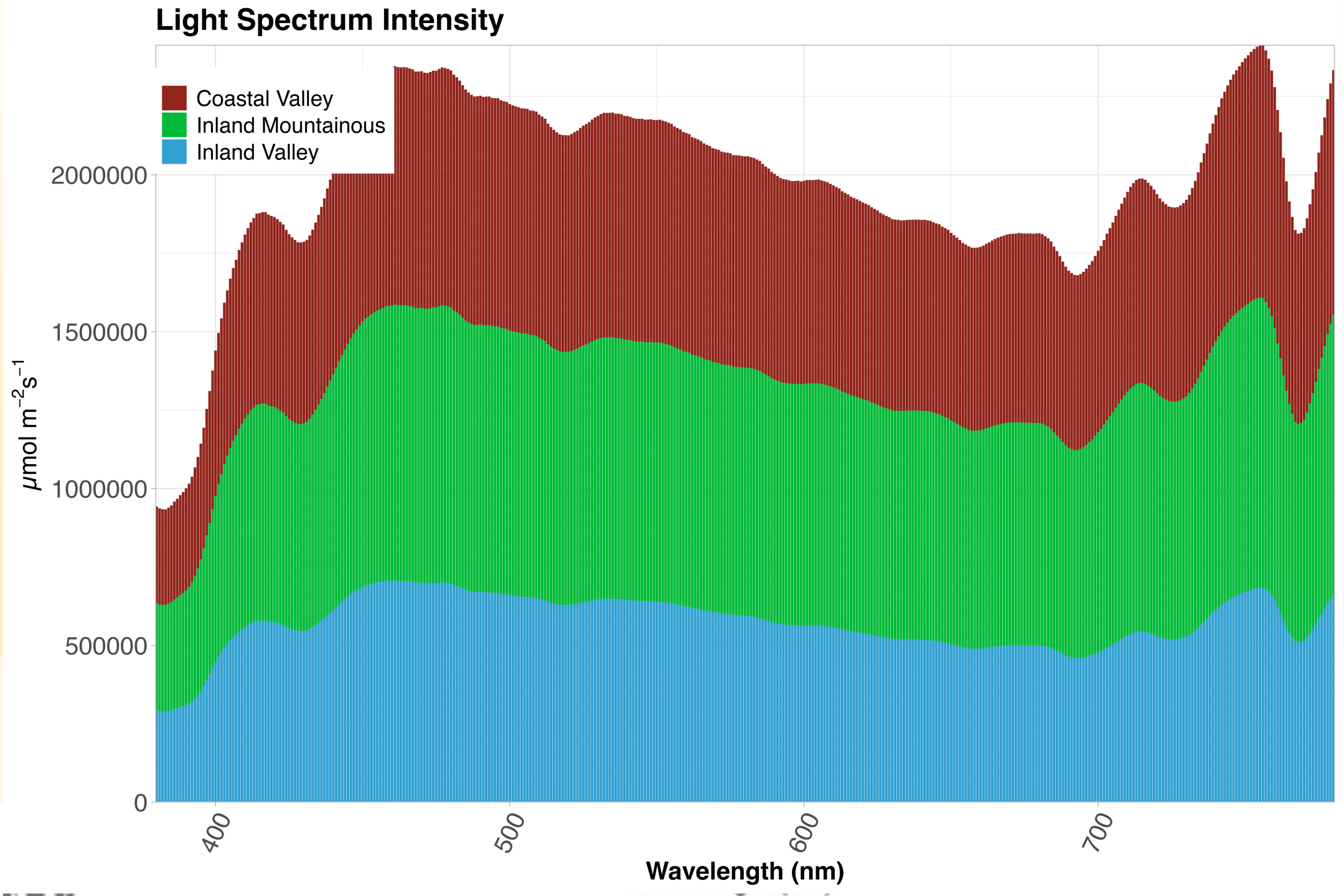
- Water use is important
- Crop evapotranspiration by geographic classification was not significantly different
- Precipitation was consistently highest in coastal valleys and lowest in inland mountain regions
- Inland mountains also lost more water to ET_c than other regions



Water Use by Rootstock

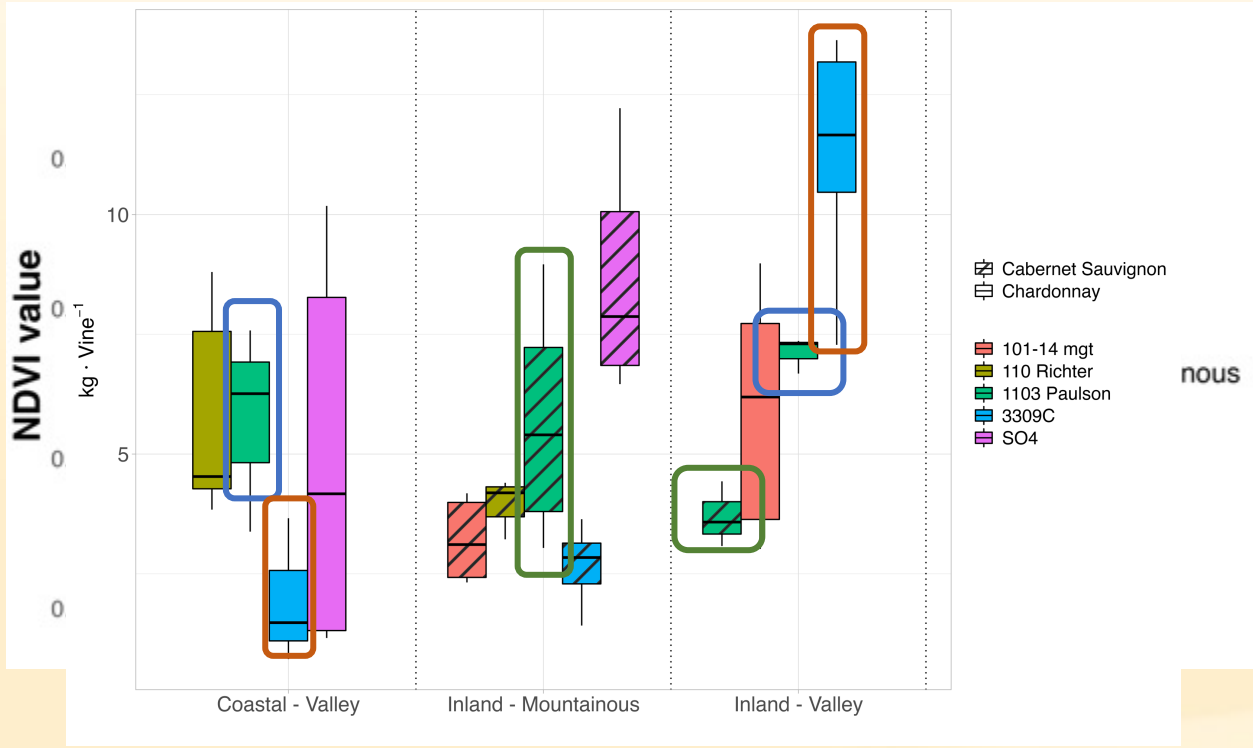
- Vine water stress varied by rootstock as well
- These data represent both scions for each rootstock listed
- Rates of vine water stress increased at consistent levels as SWP dropped in summer
- Vine recovery varied by rootstock
  - 110R recovered fastest with pre-harvest irrigation event
  - Other rootstocks recovered at a slower rate




Light Spectrum Intensity
Coastal Valley
Inland Mountainous
Inland Valley
2000000
1500000
1000000
500000
0
µmol m⁻²s⁻¹
400
500
600
700
Wavelength (nm)

Agronomic Performance

- Factors that were significantly different by rootstock or site
  1. Growth rate (NDVI)
  2. Clusters per Vine
  3. Yield per Vine
- Some rootstock ~ scion combinations performed consistently regardless of site
- Other combinations were influenced by site significantly



Site Conditions or Rootstock?

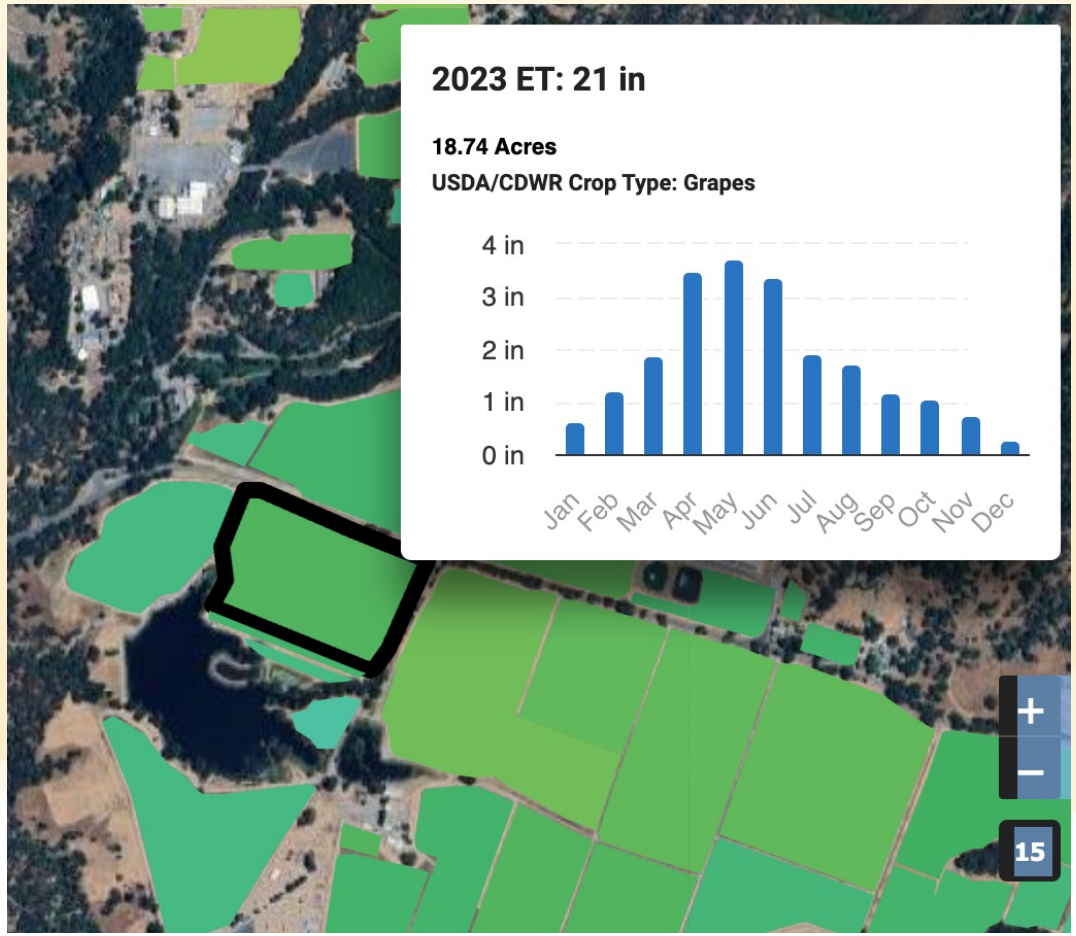
- It's both
- Site influence > Rootstock influence
- Rootstock alone impacted:
  - Yields
  - Individual Cluster Weights
  - Vine Water Status
  - Cluster Counts per Vine
- Site/Geographic classification impacted
  - Yields
  - Individual Cluster Weights
  - Berry Size
  - Vine Water Status
  - Cluster Counts per Vine
  - Sugar Accumulation

How to Assess Climate at Your Vineyard

- CIMIS / Weather Stations
- Temperature loggers
- Soil ~ Water interactions
- Other soil characteristics (i.e., texture)
- Resource access and availability
- Spectrophotometers

Use Online Resources to Assess your Site

- CropManage
  https://cropmanage.ucanr.edu/
- OpenET
  https://etdata.org/
- CIMIS
  https://cimis.water.ca.gov/
- UC IPM
  https://ipm.ucanr.edu/



Summary

1. Climate challenges may be addressed with beneficial traits present in existing cultivars

2. Quantify site conditions before drawing conclusions on potential for climate-adaptability of a site

3. Short-term solutions, like artificial light modification, may be useful when cultivars are locked in

4. Site Conditions > Rootstock

Research funding provided by

OPTI-HARVEST

CALIFORNIA GRAPE ROOTSTOCK COMMISSION

Thank You

Sources

You can find this presentation at:

1. https://ucanr.edu/sites/chenlab
2. Speaker Presentations
3. “Other Presentations”
4. “UC Davis – Emerging and Future Climate Challenges in Vineyards”

Some original images created by OpenAI Labs Dall-E Program