North Cost Viticulture

Growing premier wine grapes in changing climates

Christopher Chen, Ph.D.

UCCE North Coast Viticulture

Some images created with Open-AI software

Extreme Heat

Extreme temperatures

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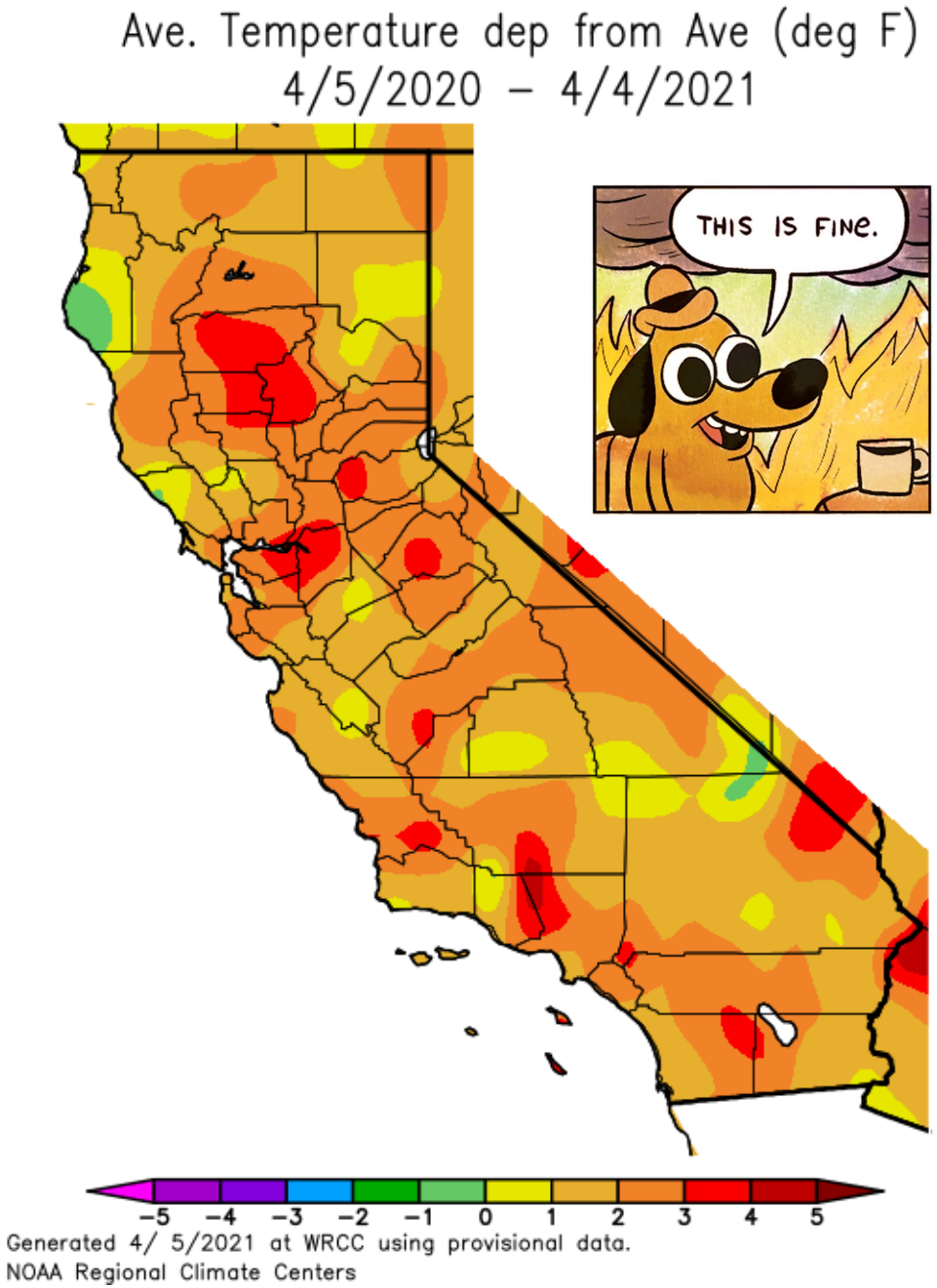
High evapotranspiration

↓

Greater water demand

↓

Damaged fruit



Credit: California Climate Data Archive (2021)

Drought

Declining precipitation

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Reservoirs not replenished

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Water scarcity for agriculture

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Long term damage to grapevines

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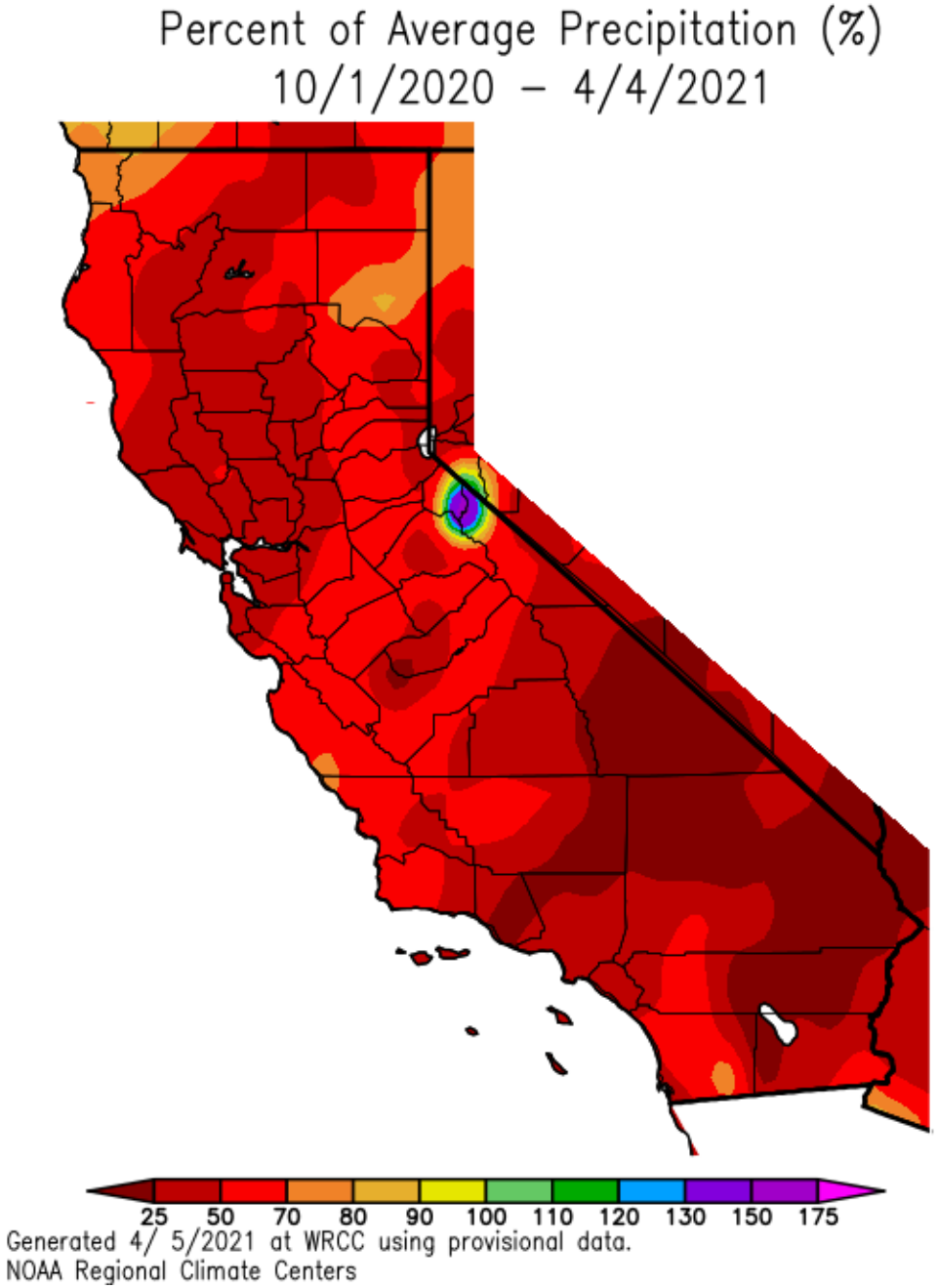
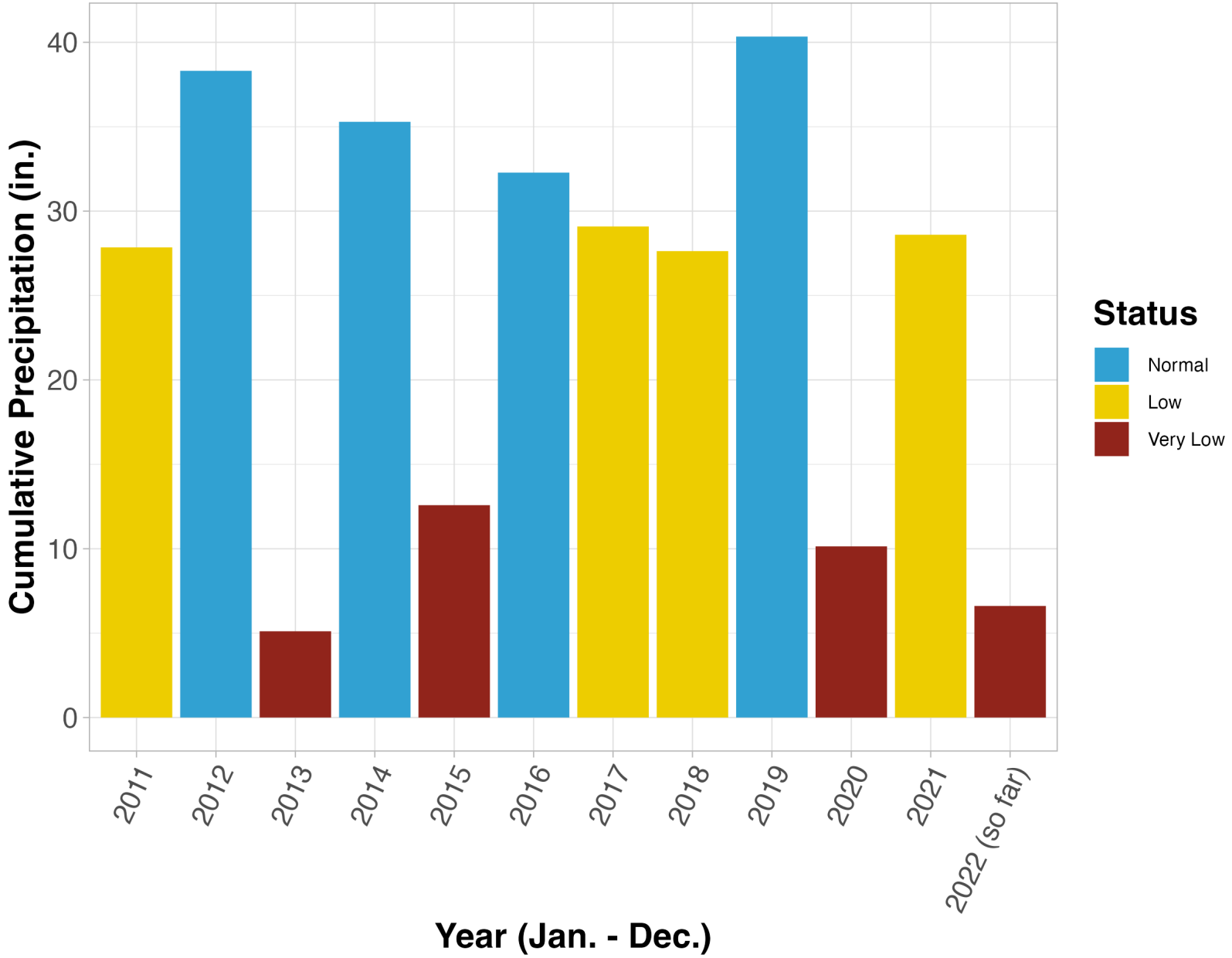
Decreases in yield

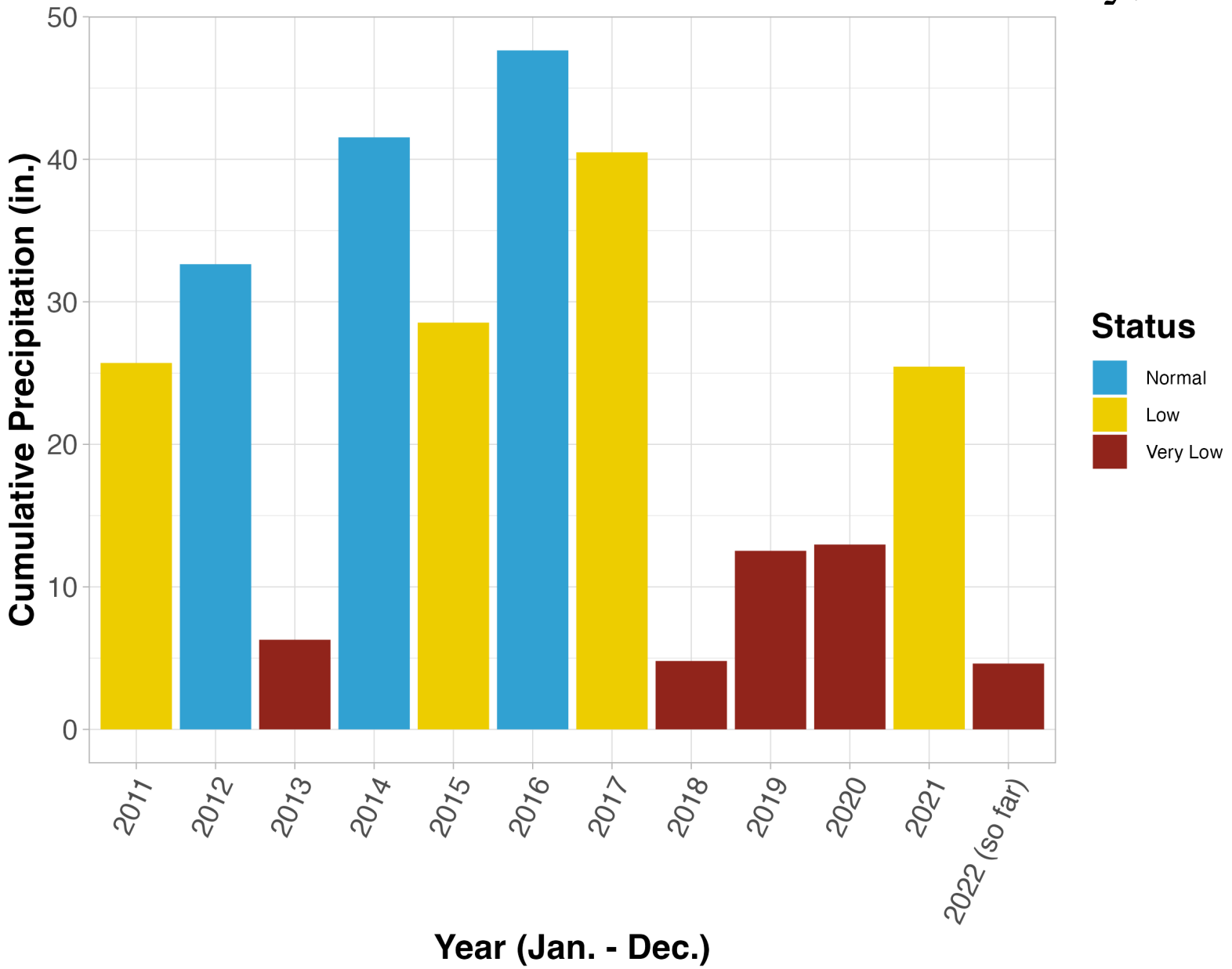


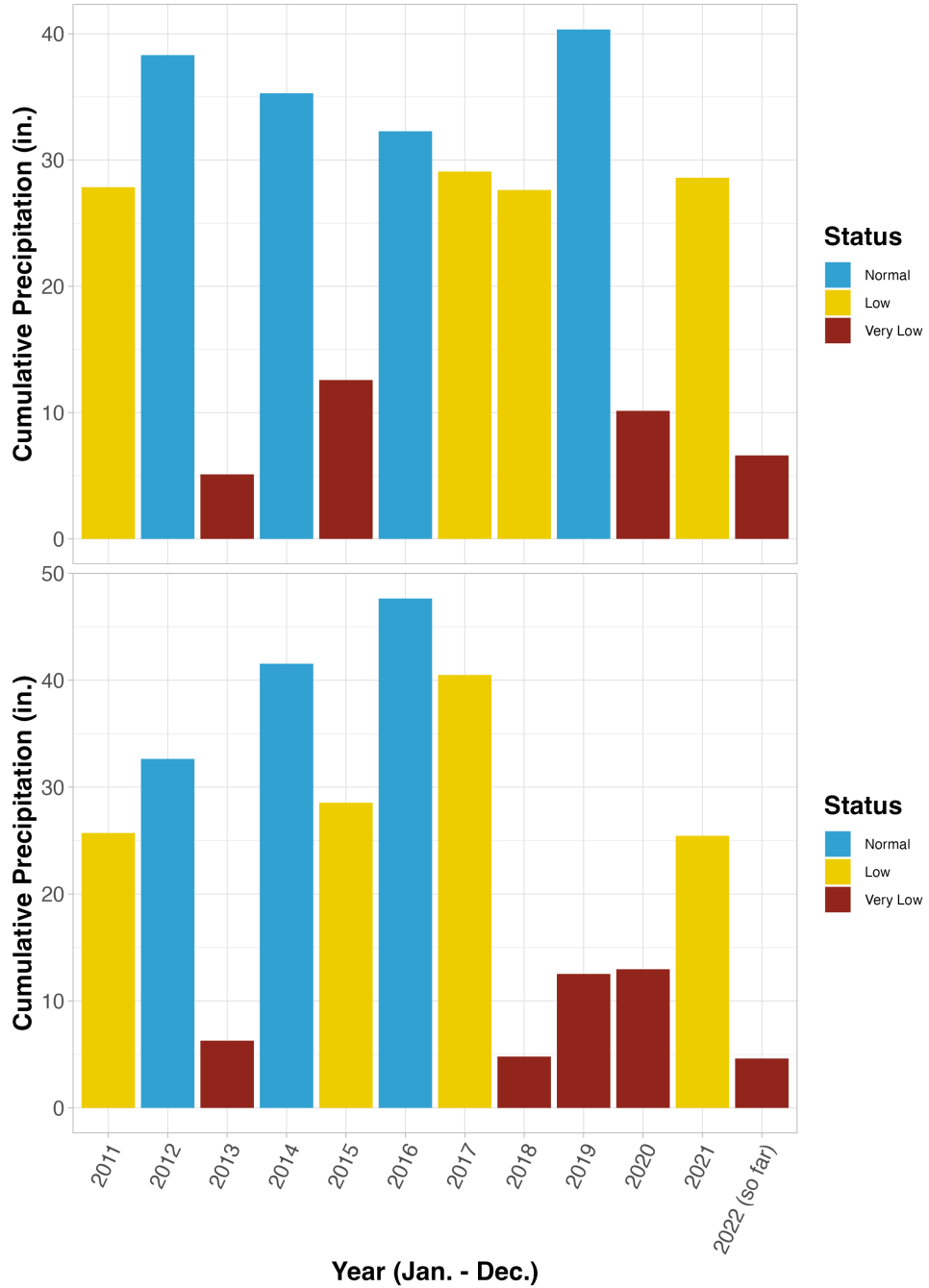
Credit: California Climate Data Archive (2021)

Total Annual Rainfall – Santa Rosa, CA



Total Annual Rainfall – Sanel Valley, CA

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30
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Low
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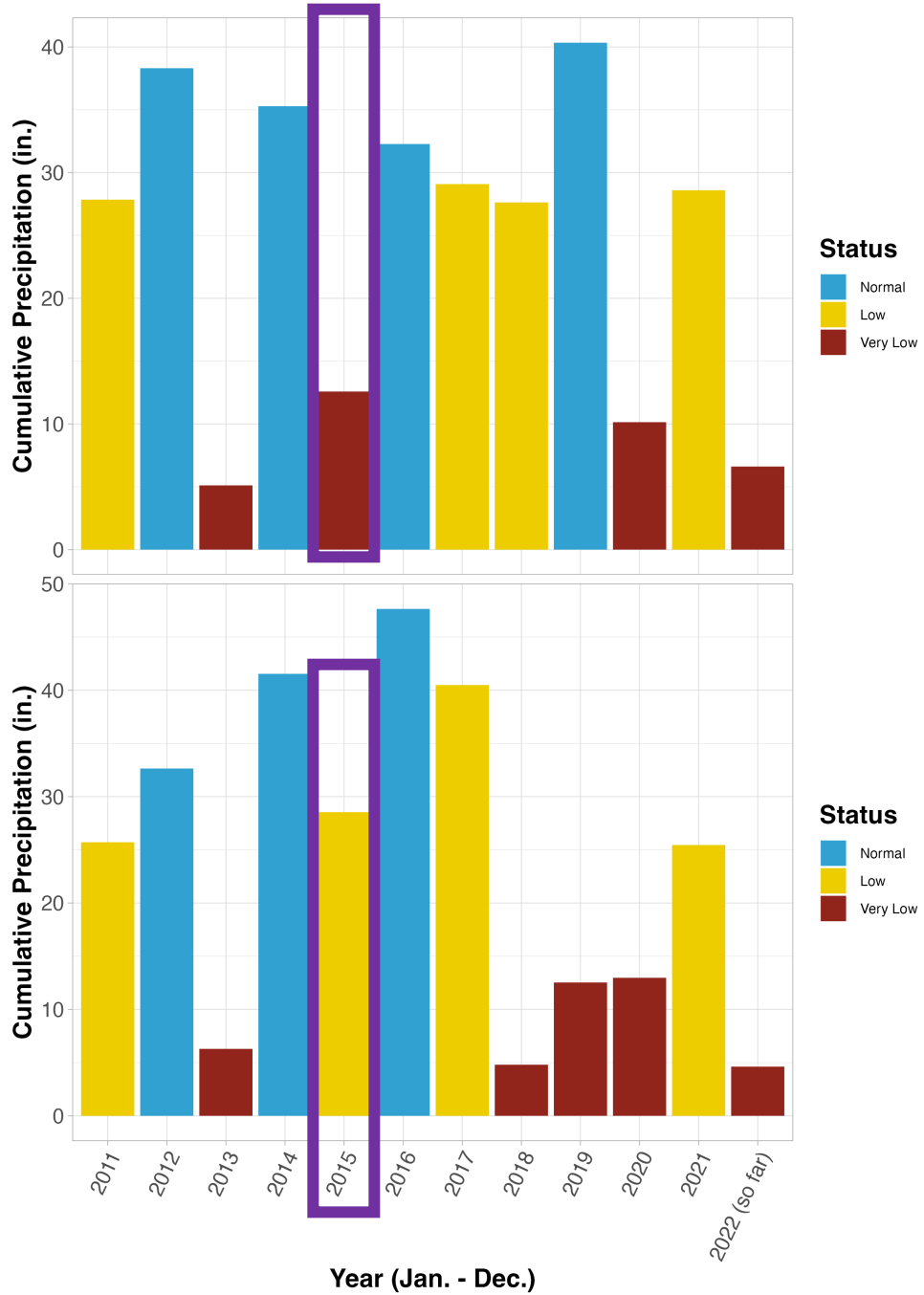
2022 (so far)
Year (Jan. - Dec.)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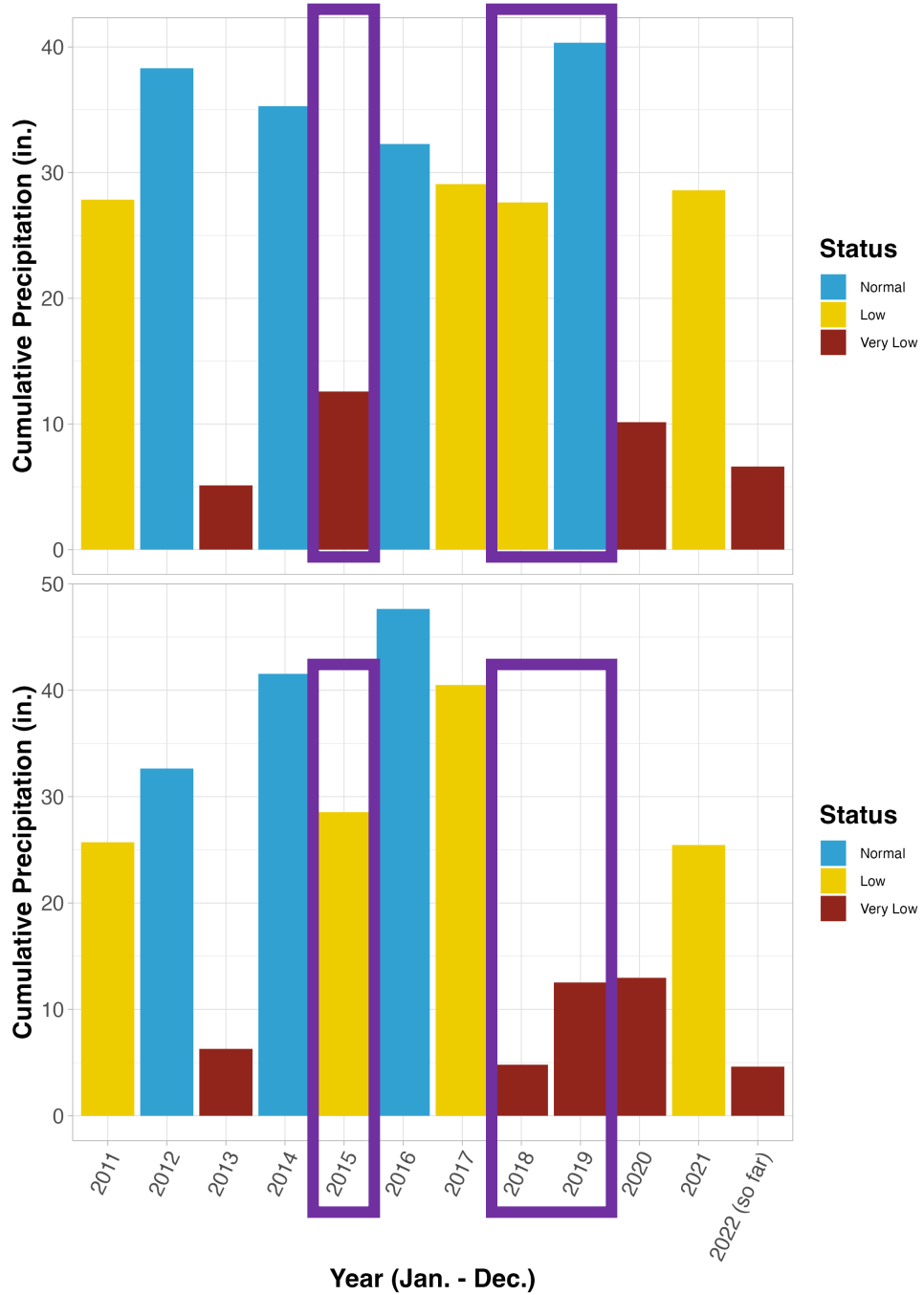
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Water use of different crops

		Water Inputs for Plant Use				
Crop System	Location	Est. Effective Precipitation (ac-in)	Irrigation Applied (ac-in)	Total Plant Water Demand (ac-in)	Frost Protection (ac-in)	Total Water Use (ac-in)
Olives	Sacramento	*12*	*36*	**48**	n/a	**48**
Almonds	S. SJV	*12*	*42*	**54**	2	**56**
Pears	Lake	*12*	*30*	**42**	18	**60**

Acre-Inch = 27,154 gallons
Acre-Foot = 325,851 gallons

Acre = 43,560 ft^2

Source: UC Davis Cost Study Reports

Water use of grapes – it depends

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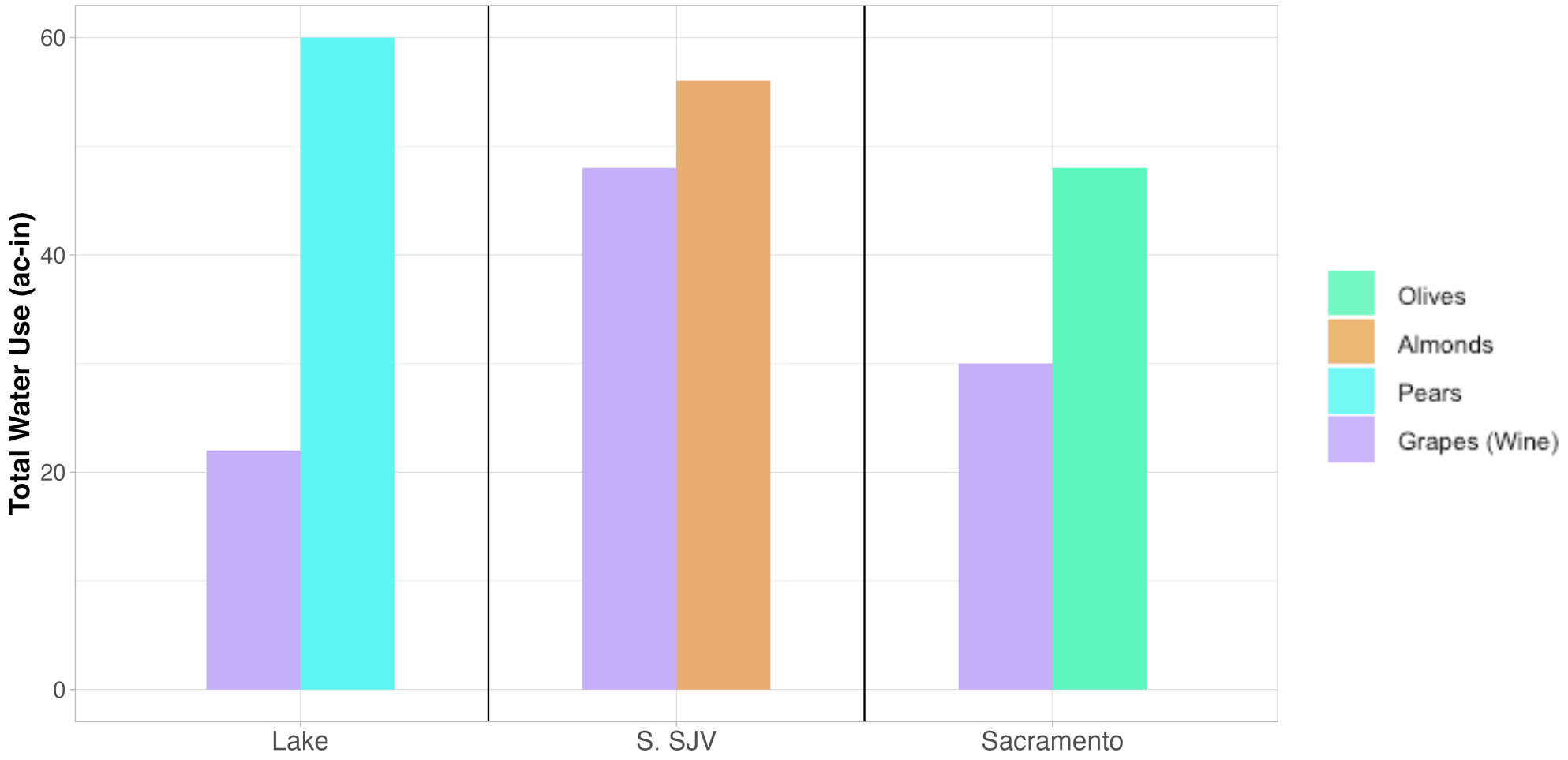
Grapes (Wine)	Lake	*12*	*8*	**20**	2	**22**

Source: UC Davis Cost Study Reports

Crop Water Demand



Source: UC Davis Cost Study Reports

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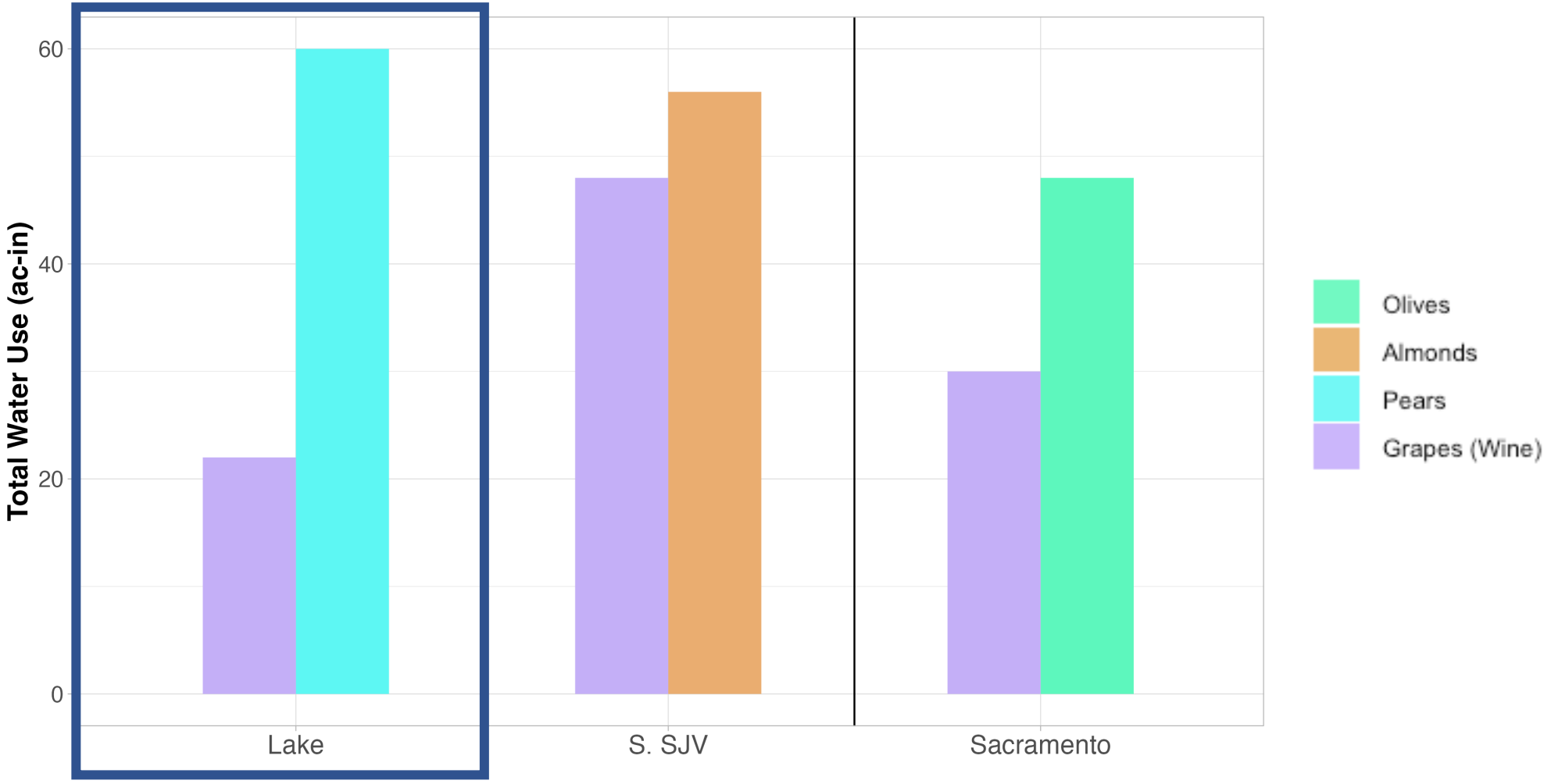


Source: UC Davis Cost Study Reports

Water Costs per Ac-Ft

Location	Crop	Est $/ac-ft	ac-in needed	Total Water $/acre/year
Lake County	Pears	$30	60	$1800
Lake County	Grapes	$30	22	$660

Source: UC Davis Cost Study Reports

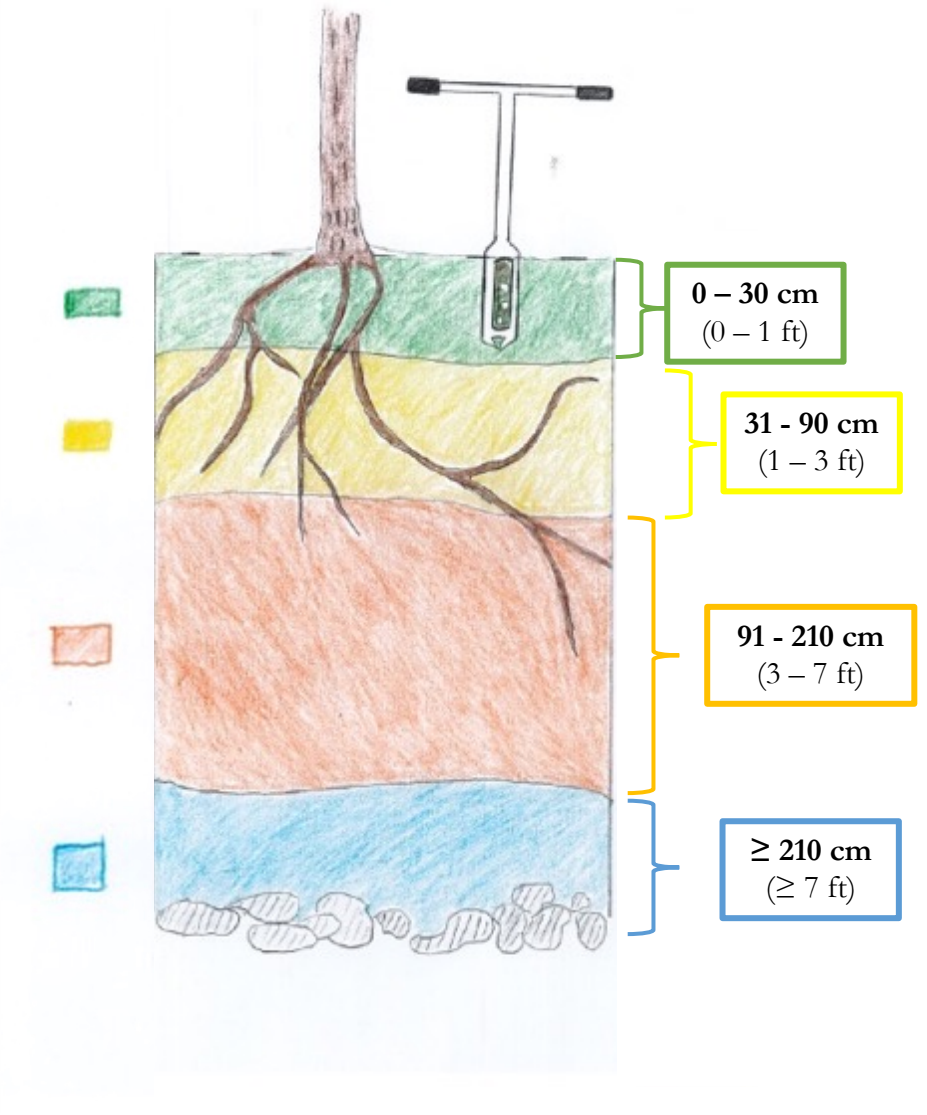
Economics of a Vineyard

1. Today average prices to install a vineyard are between **$40,000 to $80,000 per acre** (depending on region)
2. Management is estimated at **$3000 - $6000 per acre**
3. First 2 to 3 years will yield no crop = no revenue
4. Land prices vary significantly by region

Overall estimated cost to establish 1-acre of vineyard in 2022:

$43,000 to $86,000

The Importance of Soils



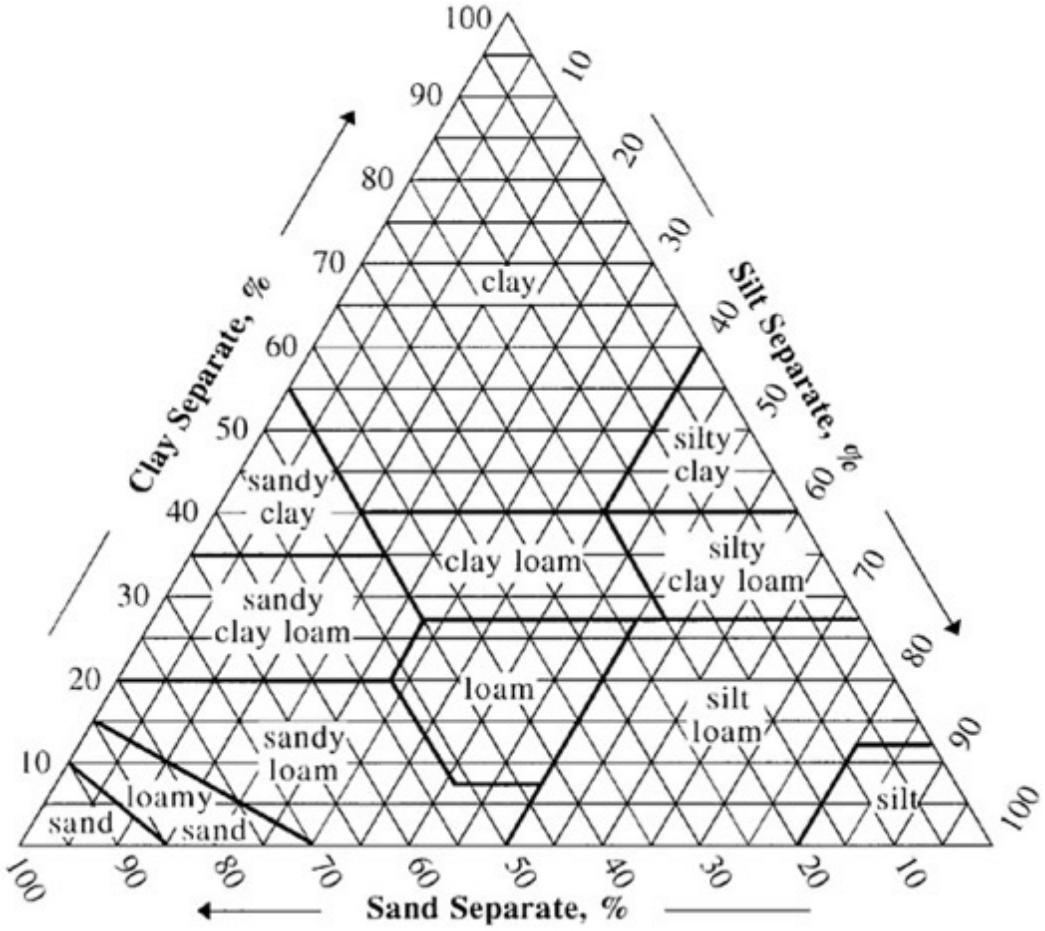
The **biological**, **chemical**, and **structural** makeup of a soil all impact how it interacts with water.

Soil is an ecosystem that needs to be 'healthy' to function

Characterizing your soils

Soil physical properties

1. **Texture** (% Sand, Silt, and Clay)
    - Understand how your soil is built
2. **Organic Matter Content**
    - Carbon acts as a sponge for water and nutrients
3. **Aggregation**
    - Clumped soil is more stable than loose soil
4. **Water Holding Capacity**
    - What is the maximum water amount it can hold?
5. **Infiltration Rate**
    - How fast does that water reach the grape roots?
6. **Bulk Density and Compaction**
    - Is your soil compacted?

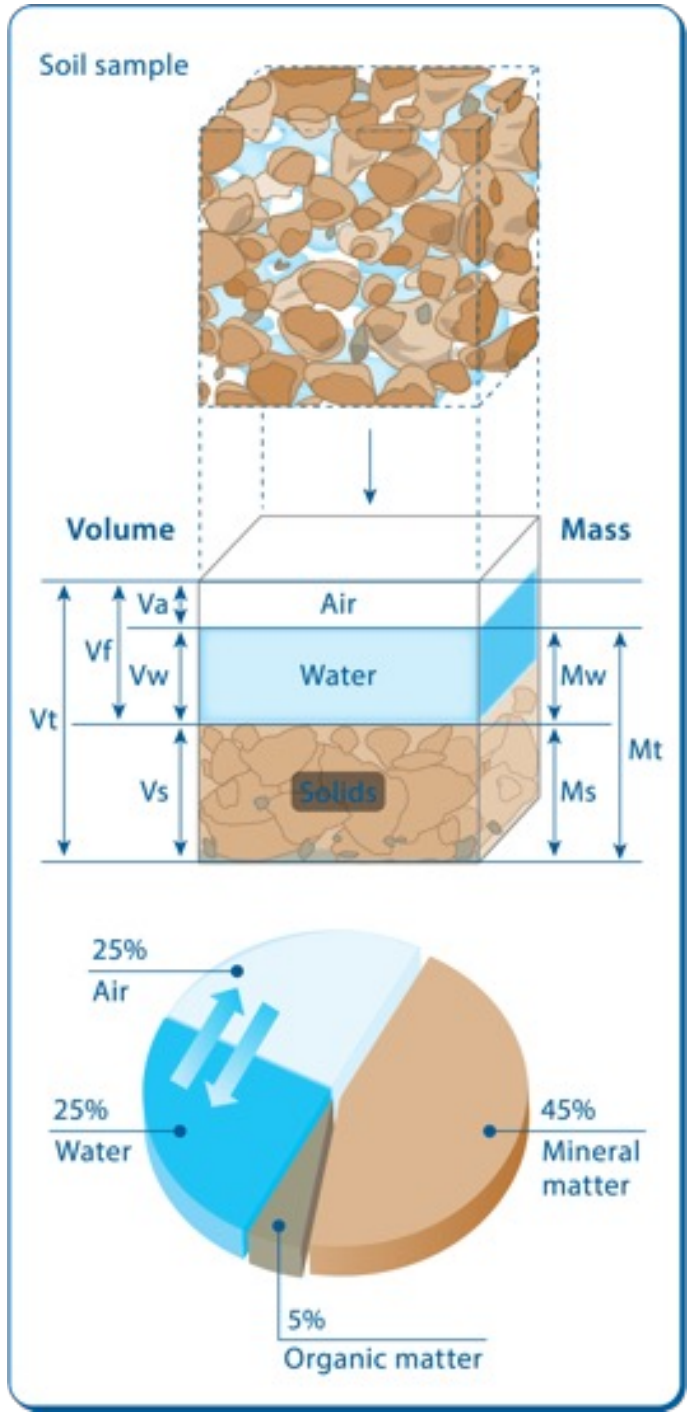


Soils on Site

- Before planting a vineyard, it is important to characterize the soils
  - Water-soil interactions
  - Soil structure
  - Soil organic matter

- ***Terroir*** = a term to summarize all aspects of a site's **physical**, **chemical**, and **biological** properties

Water Efficiency* in Vineyards



* It's related to soils

Selker and Or 2019, *Soil Hydrology and Biophysics*

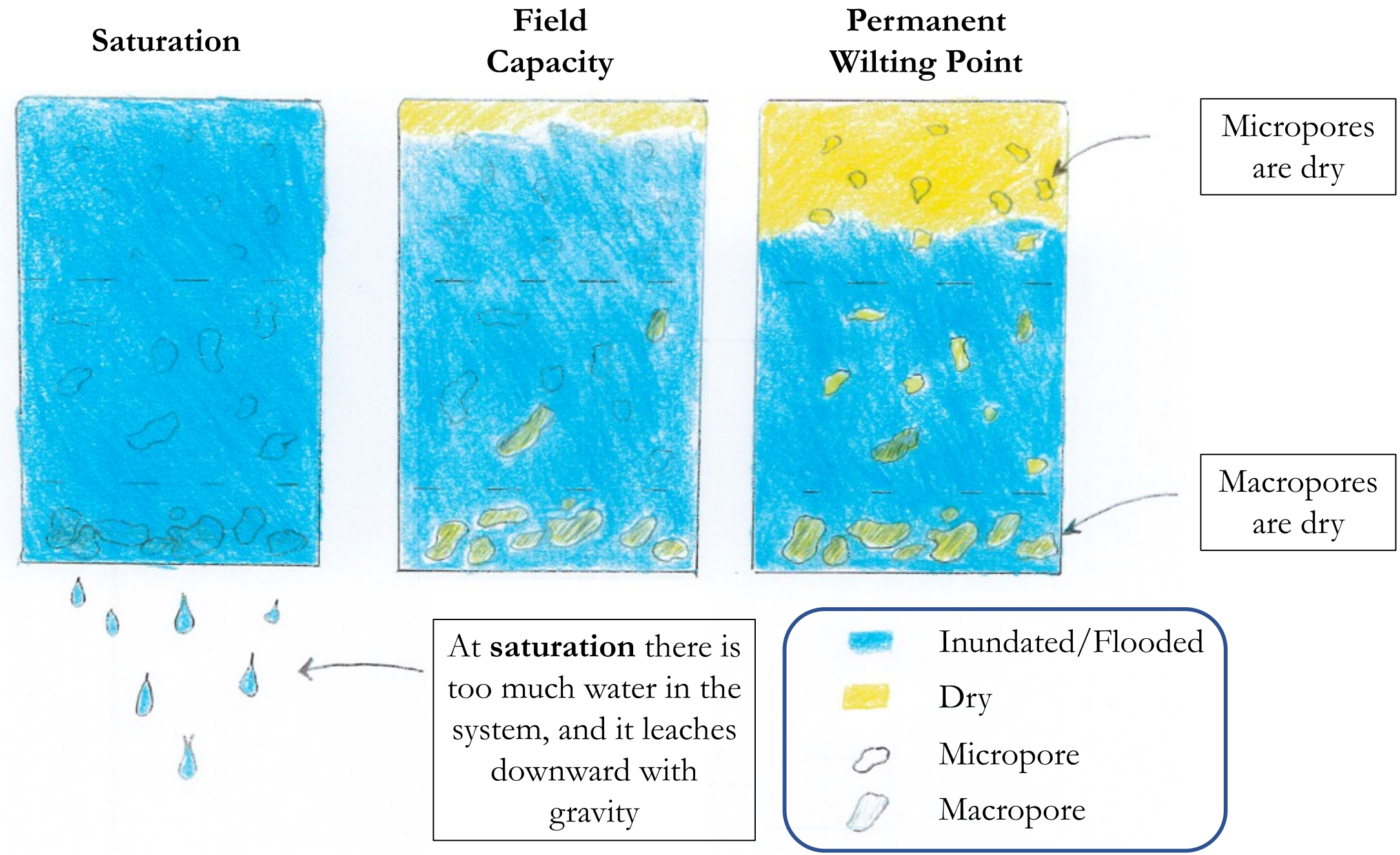
Testing Soils – Water Holding Capacity (WHC)

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


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

Testing Soils – Water Infiltration Rate

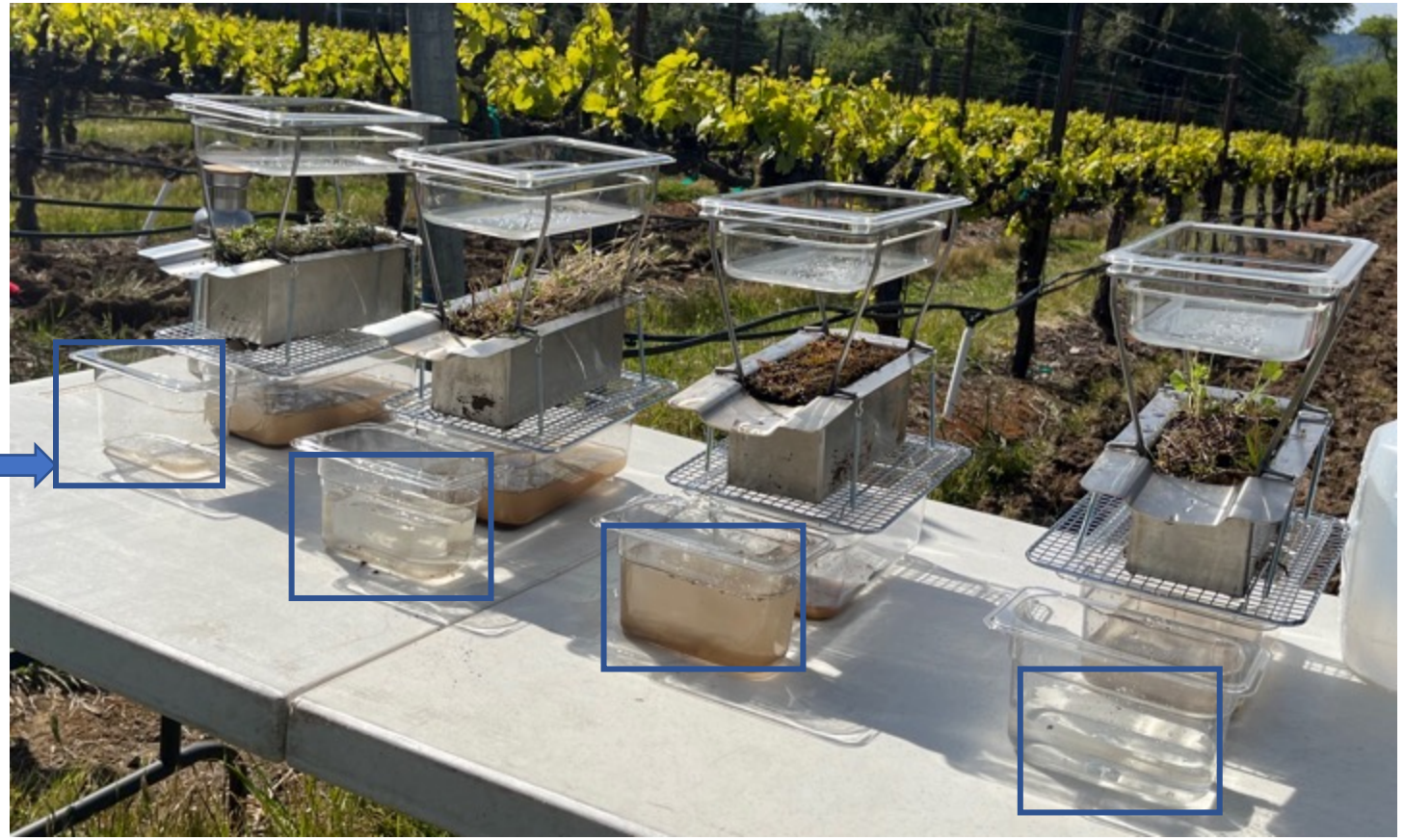
How much water can get into the soil profile and how quickly?

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 runs-off of the soil without infiltrating



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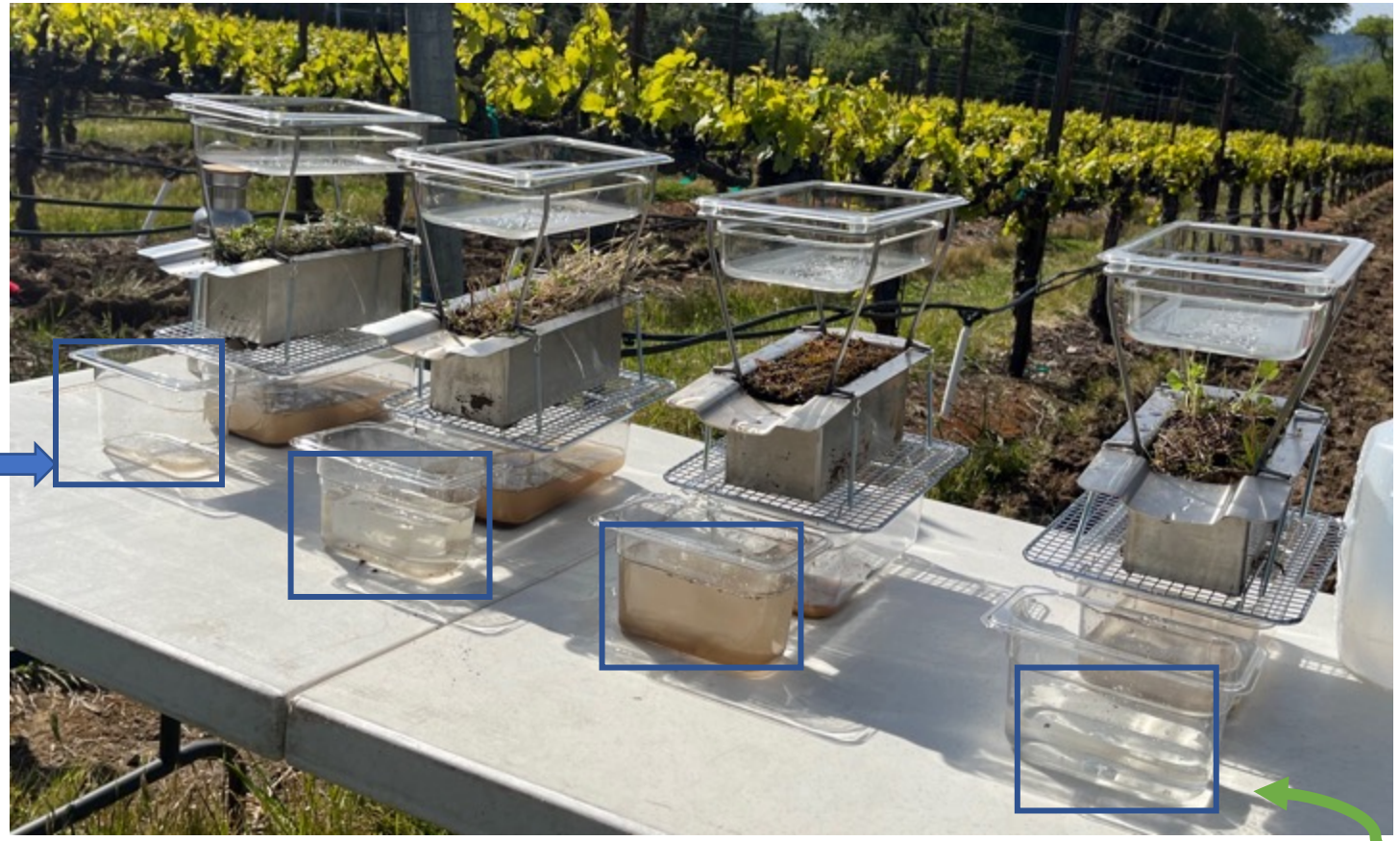
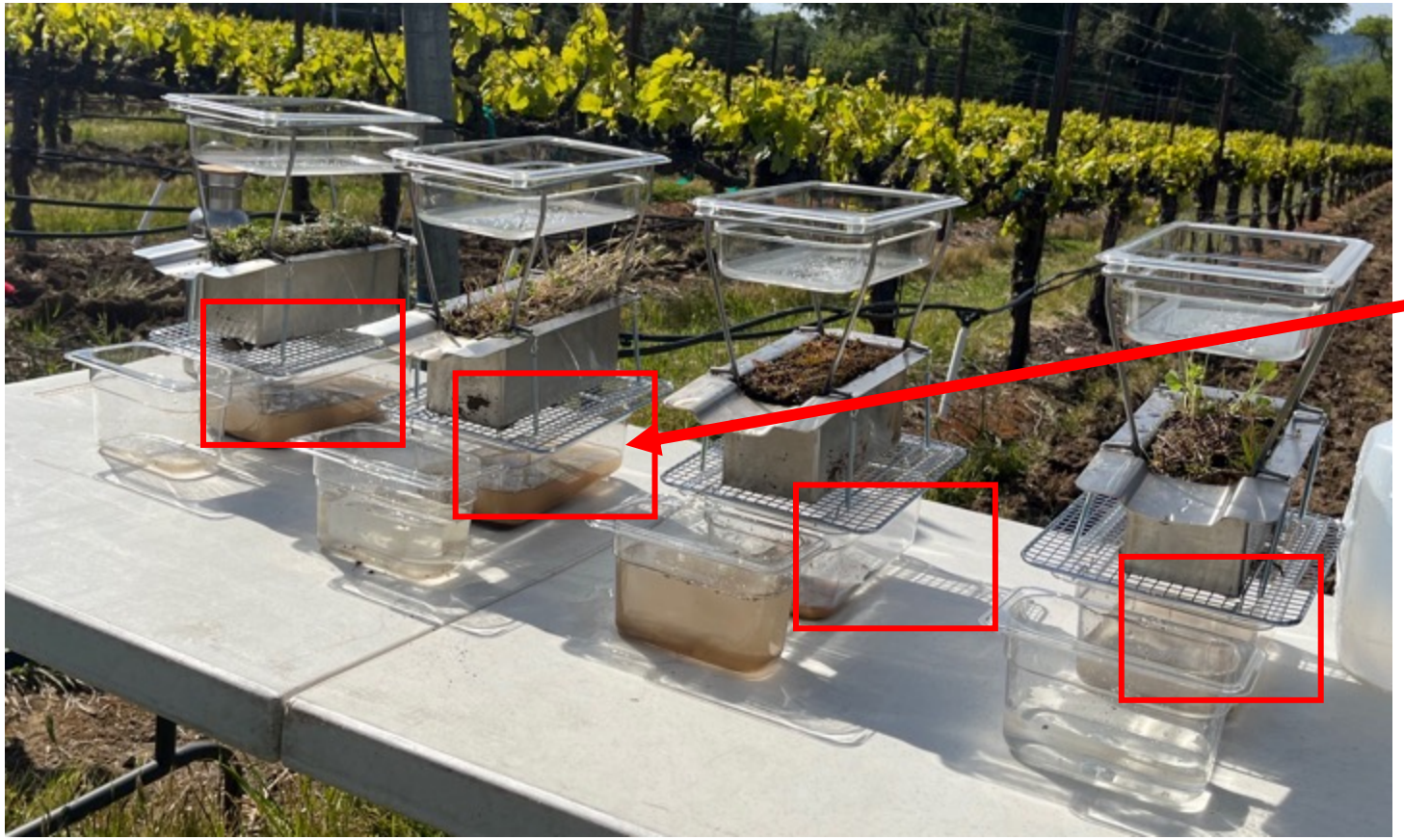


How much water runs-off of the soil without infiltrating

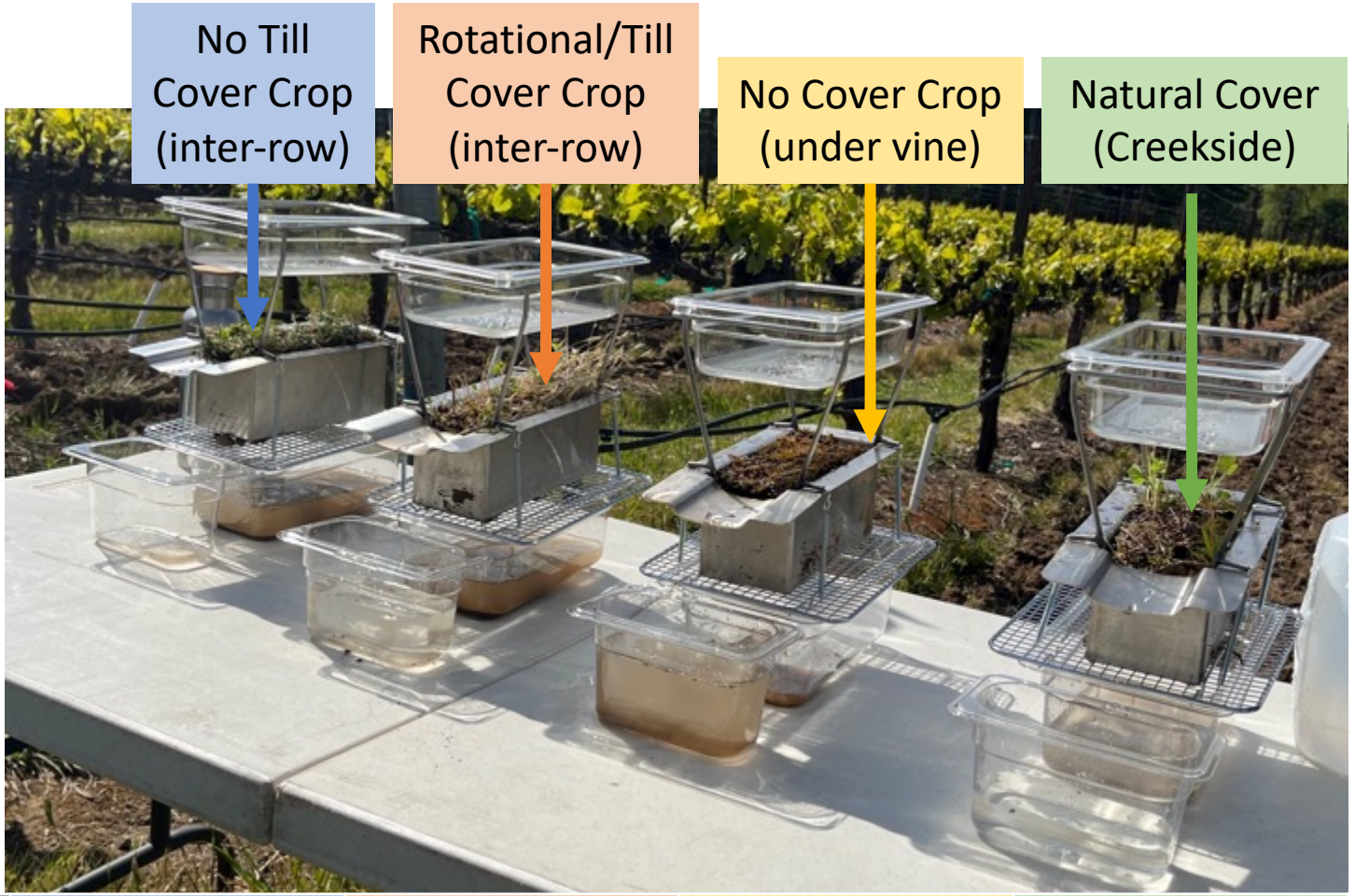
How clean is the runoff water?

Testing Soils – Water Infiltration Rate



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

Testing Soils – Water Infiltration Rate



Process	No-till Cover	Rotated Cover	No Cover	Natural Cover
Infiltration	2	3	4	1
Runoff	1	3	4	2

Rankings:
1 = Best Performing
4 = Worst Performing

Improving Soil-Water Dynamics

Tools for Agriculture:

1. Cover Crops
    - Imitates natural systems (e.g., riparian river/stream banks)
2. Decreasing Compaction
    - Leads to less 'hardpan' soils
3. Adding Soil Organic Matter
    - Acts like a sponge for water and nutrients
4. Maintaining Soil Structure
    - Dirt-clods help maintain air/water pockets in the soil

Conserving Water in the Vineyard

1. Utilizing Cover Crops
    - Improved water infiltration
    - Improved water holding capacity
2. Irrigation design and maintenance
    - Flood vs. Drip vs. Microsprinklers
    - Patching leaks and breaks
3. Frost protection
    - Overhead irrigation vs Vineyard fans
4. Canopy management
    - Smaller canopy = less water transpired

Selecting drought-tolerant cultivars

1. Planting drought-tolerant varieties helps

2. This depends on the 'Rootstock-Scion' combination effects
   - Rootstocks act as the roots; the deeper they are the more resilient to drought
   - Scions transpire water; the more efficient they are, the less water is needed

3. See UC Davis's Rootstock Guide for info: https://iv.ucdavis.edu/files/24347.pdf

(Ag)venturous Trials

1. **Lake County Variety Trial**
   - 'Old-school' trial to find the most effective varieties for a changing climate
   - Located in Red Hills AVA here in Lake County
   - Not much has come out of this yet.

2. **Climate Adaptive Varieties (not "Varietals")**
   - New study/survey to identify the potential pathways for climate-adaptive vineyards to take
   - Recently funded by California Grape Rootstock Improvement Commission
   - Will cover Lake, Mendocino, and Sonoma Counties

(Ag)venturous Trials

3. New Technologies Studies

- Identifying new technologies for maintaining high quality vineyard production
- Ranges from low to high tech solutions
- Effectiveness of the products is what is up for debate
- Adoption of the technology will depend on individual growers and the culture of viticulture by region


Thank You