INTEGRATED GRAPE TEAM

Grape Growing in Today's Environment

University of California Cooperative Extension UC
MASTER GARDENERS OF NAPA COUNTY

Need more Information:

Help Desk
Monday and Friday
9:00 AM – 12:00 Noon
(707) 253-4143
E-mail: mastergardeners@countyofnapa.org
http://NapaMG.org

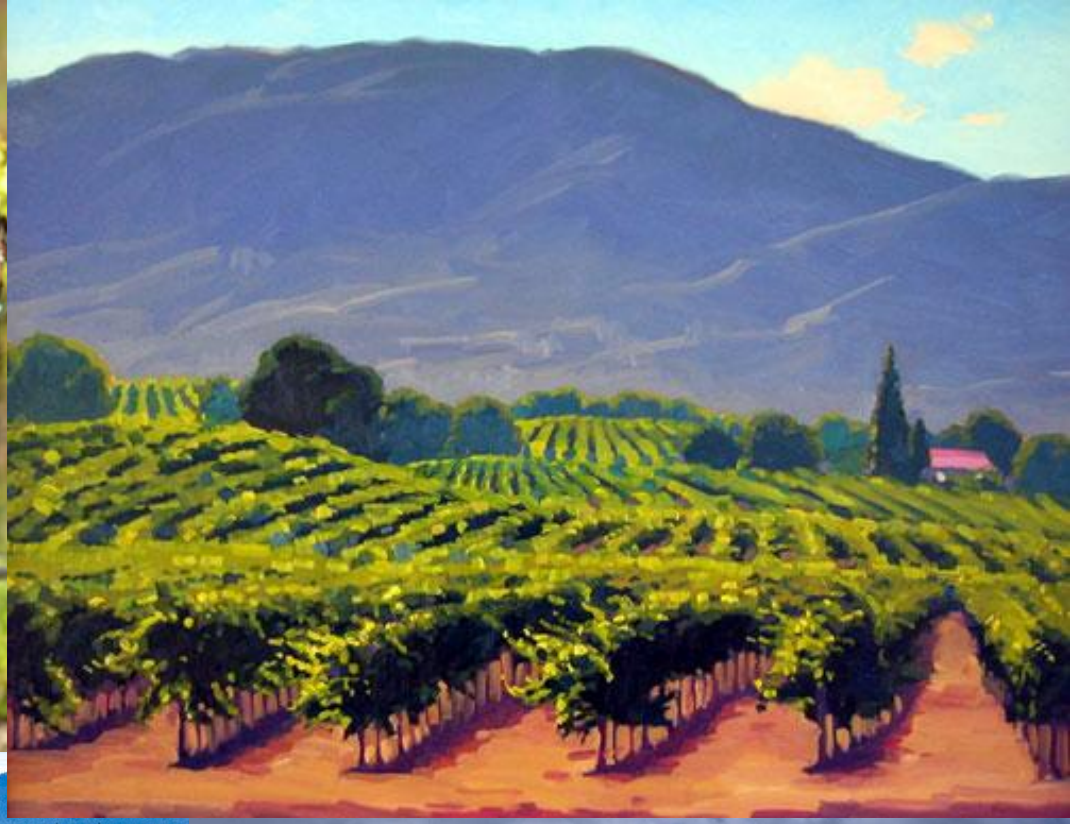
WEB SITE: WWW.IPM.UCDAVIS.ED Integrated Pest Management PEST NOTES

What questions do you have for us?

- How many have vineyards?
- How big?
- What varietals?
- Where are they located?
- Are you aware of Integrated Pest Management (IPM)?
- Do you sell your grapes?
- Vineyard Management (DIY or professional)
- Any problems?

OUTLINE OF WHAT WE ARE COVERING TODAY

- INTRODUCTION – (9:30 – 9:40)
- CALENDAR OF EVENTS IN A VINEYARD,, ANNUAL GROWTH CYCLE, - (9:40 – 9:55)
- VINEYARD FLOOR MANGEMENT/ COVER CROP (9:55 – 10:15)
- CANOPY MANAGEMENT – (10:15 – 10:30)
- PRUNING – (10:30-10:40)
- SOIL HEALTH, REGENERATIVE FARMING, CLIMATE CHANGE, CARBON, PHOTOSYNTHESIS, SOIL FOOD WEB – (10:40 – 11:00)
- BREAK – (11:00 – 11:10)
- PETIOLE TEST REVIEW – (11:10 – 11:20)
- VINE NUTRITION AND FERTILIZATION – (11:20 – 11:30)
- POWDERY MILDEW – (11:30 - 11:40)
- INTEGRATED PEST MANAGEMENT – (11:40 – 11:55)**)**
- IRRIGATION TIMING AND TECHNIQUES – (11:55 – 12:05)
- DROUGHT AND DRY FARMING – (12:05 – 12:10)
- QUESTIONS - (12:10 – 12:30)



Calendar of Events

- WEATHER
- HARVEST
- VITICULTURE OPERATION
- PEST MANAGEMENT

WEATHER

- Rain
  - or lack of it
- Frost Danger
- Heat spell hazard

HARVEST

- Wine Grapes

early (sparkling wines)

mid season (whites /pinot noir)

late (Cabernet Sauvignon, Merlot)

VITICULTURE OPERATIONS

- Shoot removal
- Plant cover crop
- Irrigation
- Pre-harvest vine preparation

PEST MANAGEMENT

- Insects and Mites
- Nematodes
- Diseases
- Vertebrates
- Weeds

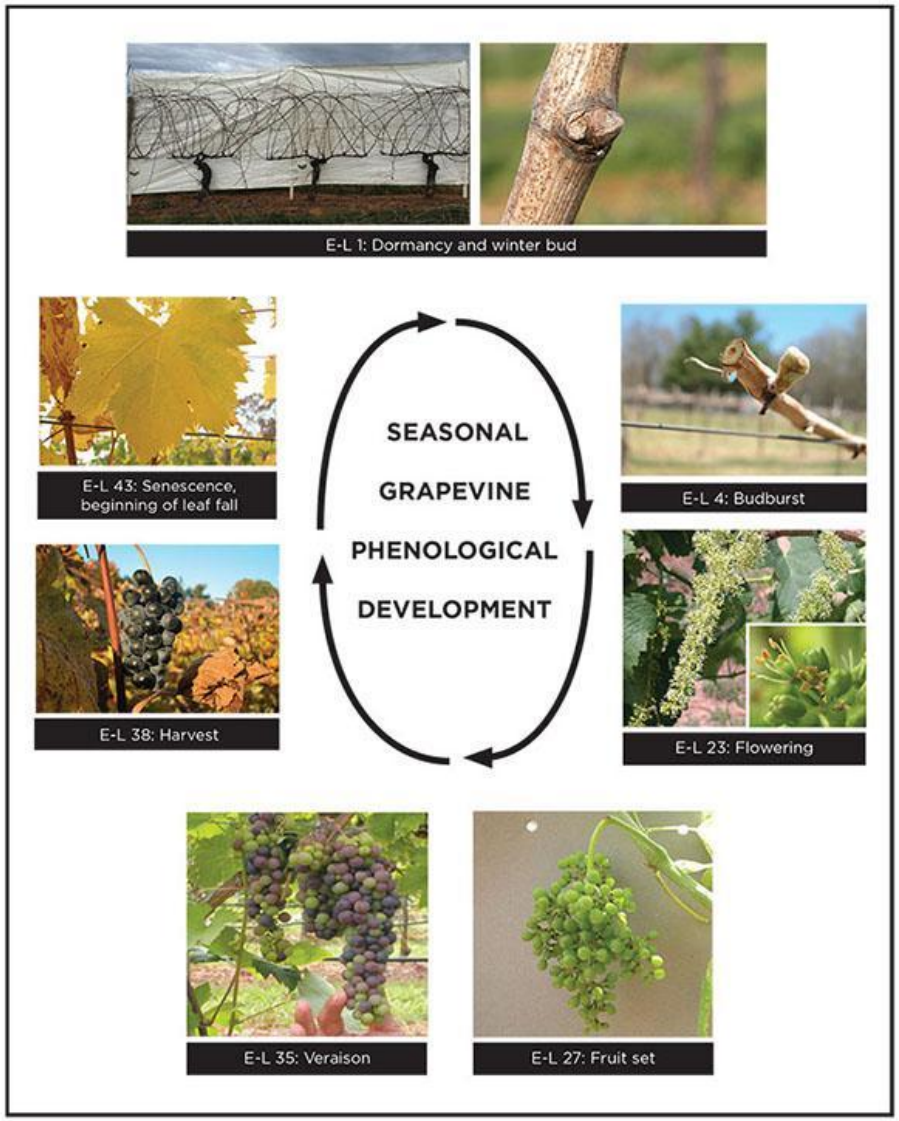
Annual Growth Cycle

------THREE INTEGRATED CYCLES------

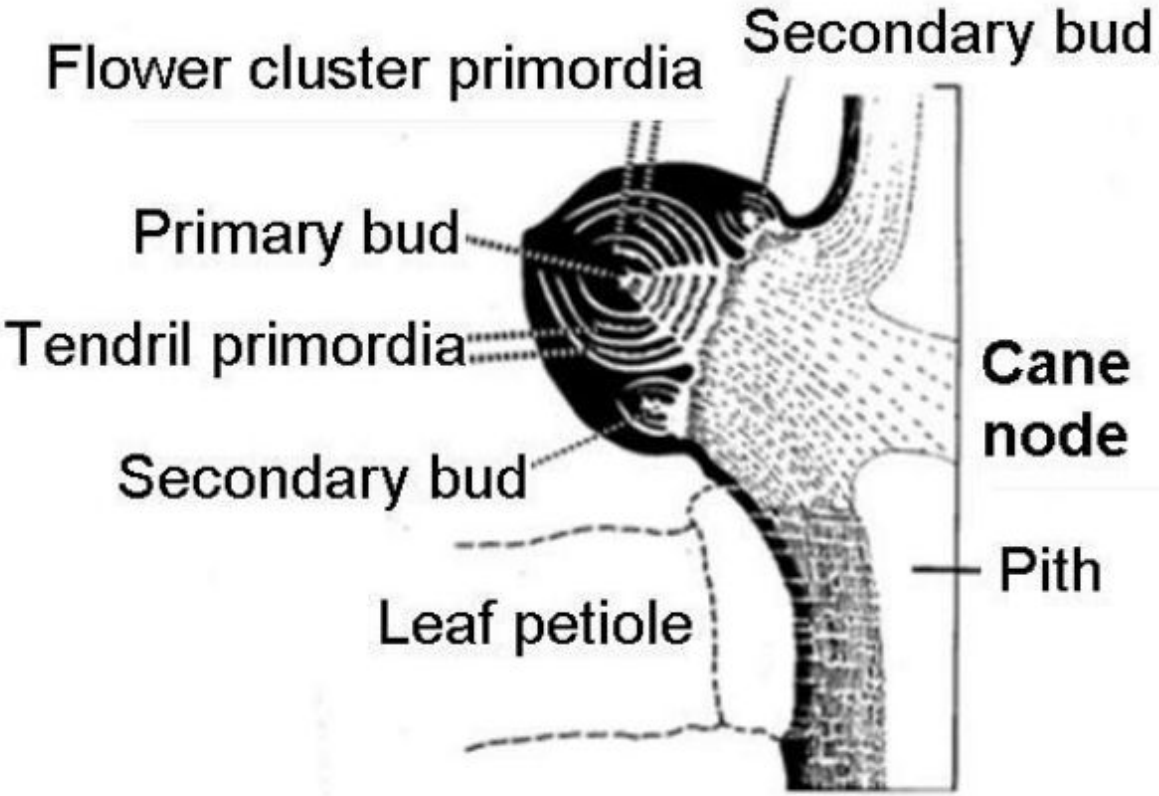
VEGETATIVE GROWTH

CLUSTER INITIATION

FRUIT GROWTH AND DEVELOPMENT

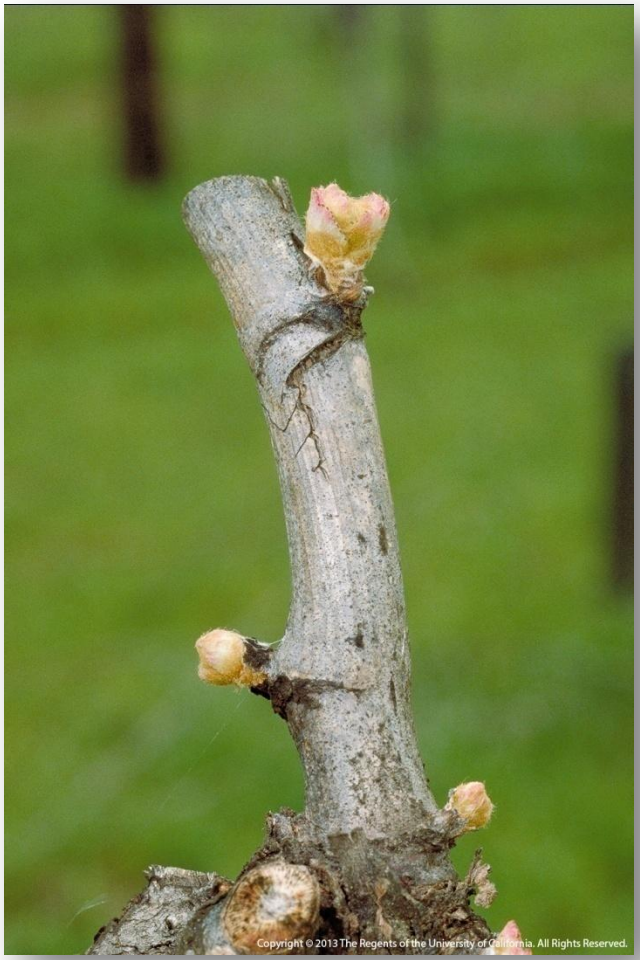


Bud


Flower cluster primordia
Secondary bud
Primary bud
Tendril primordia
Secondary bud
Leaf petiole
Cane node
Pith

Compound Bud

Dormant Bud | Bud Break



Early Shoot Growth
Flat Leaf Stage

Early Shoot Growth
Six-inch Shot

Vine Growth
At the Beginning of Bloom

Annual Growth Cycle

CLUSTER INTIATION

- All formed in the bud, fruit cluster or tendril
- Influenced by environment
- Flower cluster formed the year prior

Bloom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Bloom Pollination

Annual Growth Cycle

FRUIT GROWTH AND DEVELOPMENT

- Grape flowers on cluster
- Self-pollinating
- Flowers bloom 6-10 weeks after shoot growth begins
- Fruit set
  - ~20-30% flowers become berries

Fruit Set

Fruit Developing

Annual Growth Cycle

FACTORS INFLUENCING GRAPE BERRY GROWTH

- GENETICS
- BIOPHYSICAL CONSTRAINTS
- ENVIRONMENT
- SOURCE/SINK RELATIONSHIPS
- WATER STRESS

Fruit Elements

Fruit Fully Developed
Veraison

Vineyard Floor Management

Keep soil covered

Vineyard Floor Management Objectives

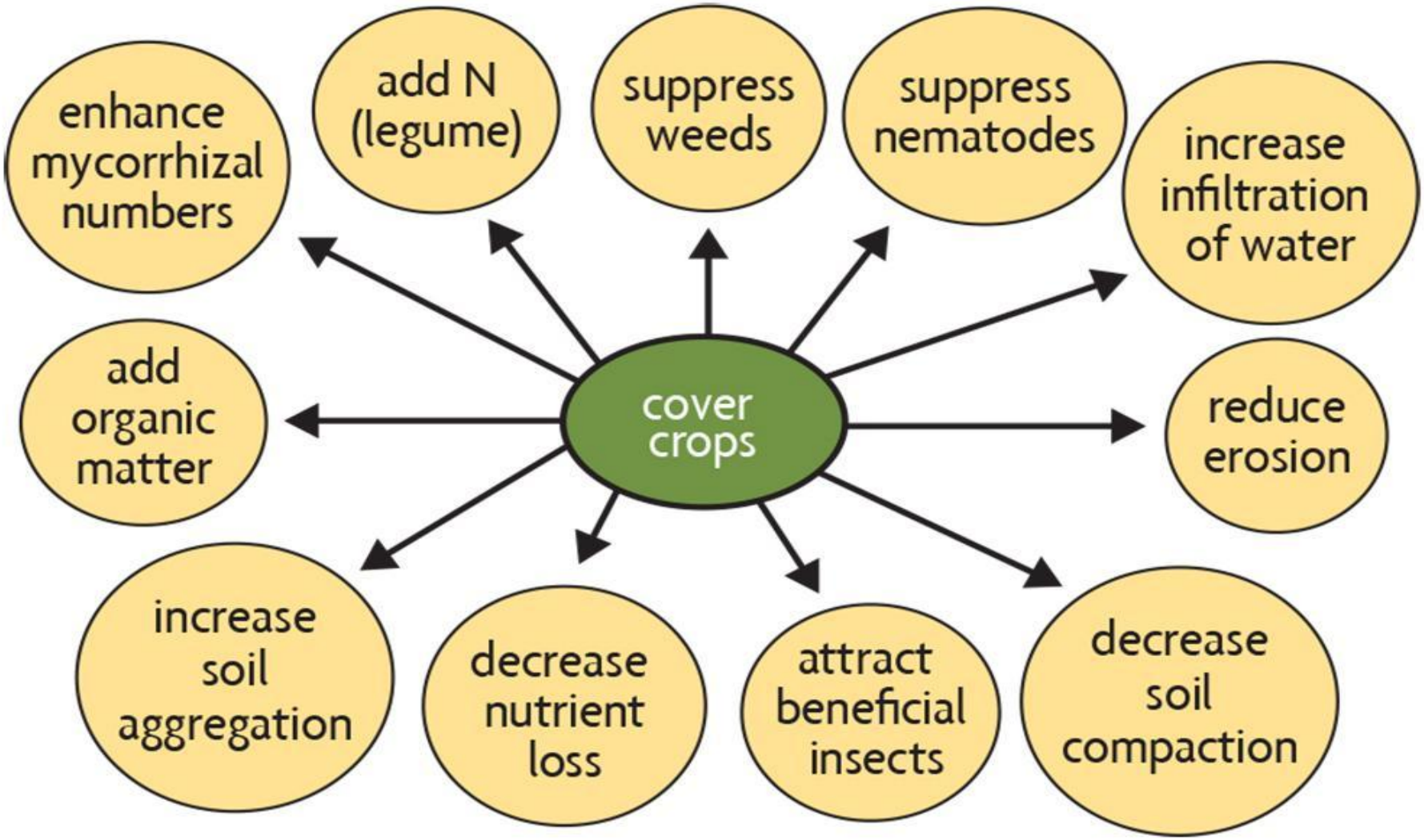
- Weed Control
- Soil Conservation
- Water Management

Weeds need to be managed to reduce competition for soil moisture and nutrients.

Cover Crops

- Timing of seeding
- Benefits
- Mowing/tilling timing
- Water Management
- Erosion Control

Cover Crops


cover crops
enhance mycorrhizal numbers
add N (legume)
suppress weeds
suppress nematodes
increase infiltration of water
add organic matter
reduce erosion
increase soil aggregation
decrease nutrient loss
attract beneficial insects
decrease soil compaction

Cover Crops

Maximize Living Roots

Compost

- Improves soil porosity
- Adds microorganism diversity
- Slow release of nutrients
- Apply 3-4 tons /acre

Mulch

- Erosion control
- Improved moisture retention

Canopy Management

It's all about Balance. . .

- *Shape*
- *Orientation*
- *Location of shoots*
- *Leaves*

Canopy Management

❑ For This Year – Why we do it

- ✔ To maximize wine grape yield, wine quality or both at the same time,
- ✔ Essential to being consistently successful from one year to the next.

A properly balanced vine, with the right ratio of shoots and leaves to fruit, is the goal, as well as striving for the right fruit exposure to light and maintaining the fruit within an optimum temperature range.

Canopy Management

Why we do it

- ❑ For Next Year

- ✔ Two critical elements:
  - Production of adequate fruit buds
  - Production of sufficient carbohydrate and nutrient reserves for the following year

Canopy Management

What Affects Balance

Vegetative Growth

Fruit Production

Canopy Management

General Crop Load Indices

- 8 Leaves per cluster
- 10 – 14 cm^2 leaf area – gram fruit weight

Canopy Management

Know your microclimate, orientation to the afternoon sun

- When to Start
  - Just Prior to or at bloom
  - Increase light on the bloom
- During rapid shoot growth
  - Suckers
  - Waterspouts
  - May need additional leaf pulling
- When to stop
  - Start of veraison
  - Prior to harvest

Canopy Management

LEAF REMOVAL TIPS

- At the beginning of berry set take off leaves in the fruiting zone to expose grapes to sunlight, as necessary.
- Be careful of too much leaf removal on the South or western sides because of potential sunburn.
- A dense canopy is also conducive to the development of bunch rot or mildew because it prevents the sprays from reaching the fruit. Air movement helps reduce moisture which leads to these conditions.

Pruning

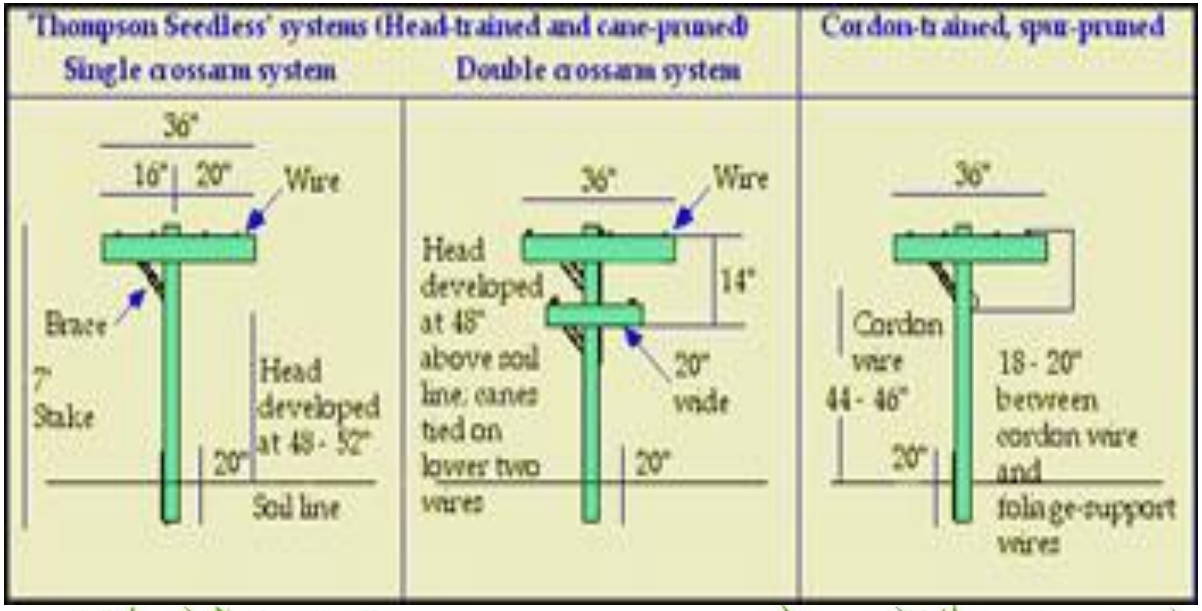
Objectives of Pruning

- Controlling the size and structure of the vine
- Regulate crop size
- Maintain a balance between vegetative growth and fruiting
  - maximizing the yield potential while maintaining the health of the plant
- Determined by trellis system

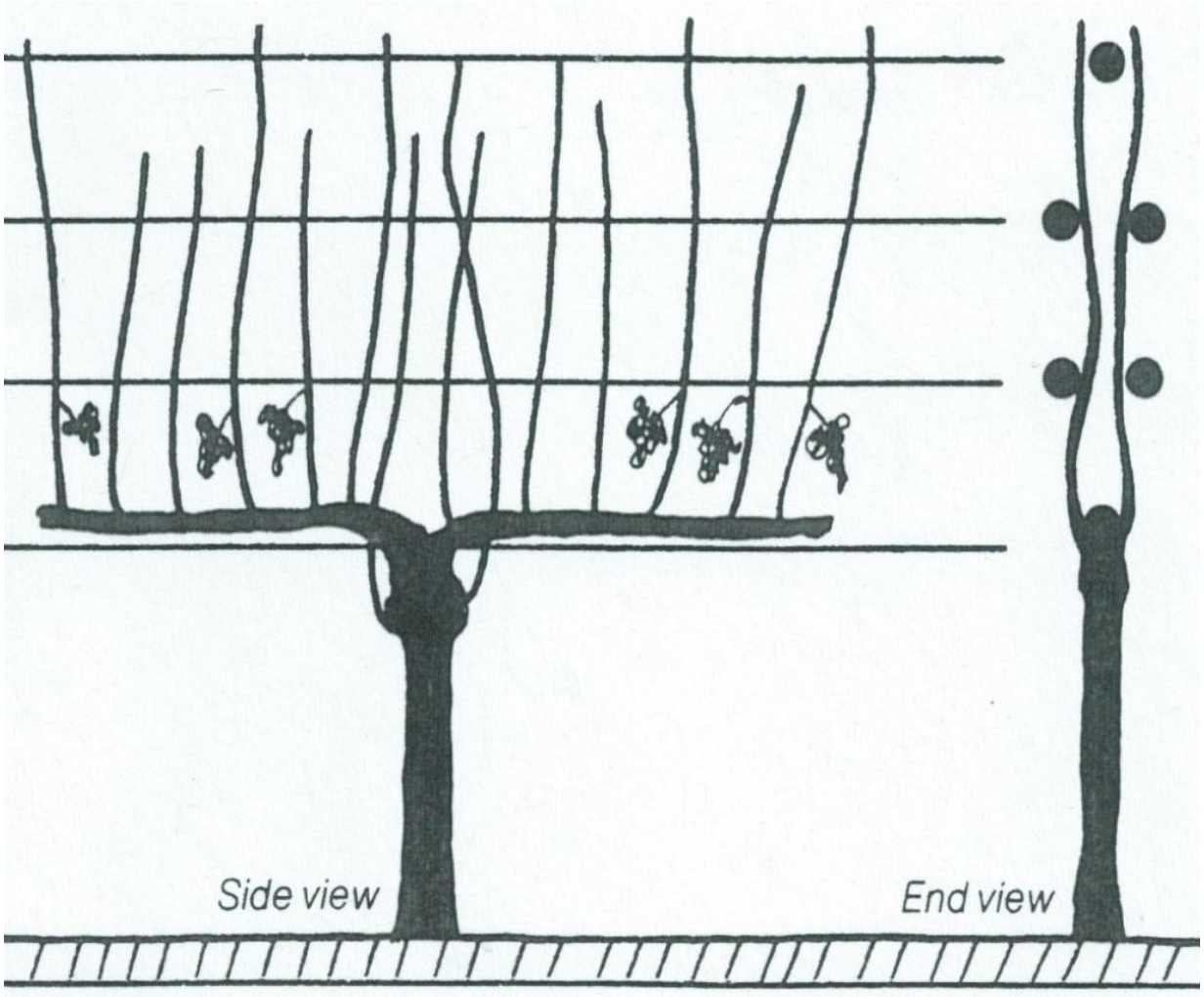
Trellis Systems

Considerations

- Cultivar
- Site
- Vine vigor
- Harvesting method
- Maintenance
- Cost



Vertical Shoot Positioned (VSP) Trellis



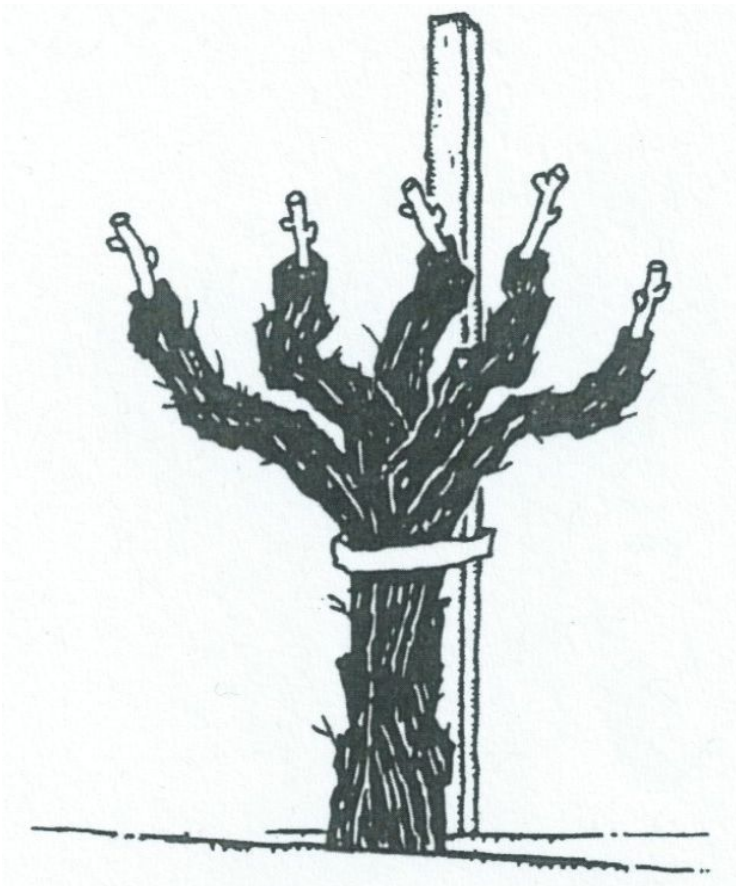
- Dominate the North Coast and Central Coast
- Used in various row widths
- Adjustable side wires

Spur

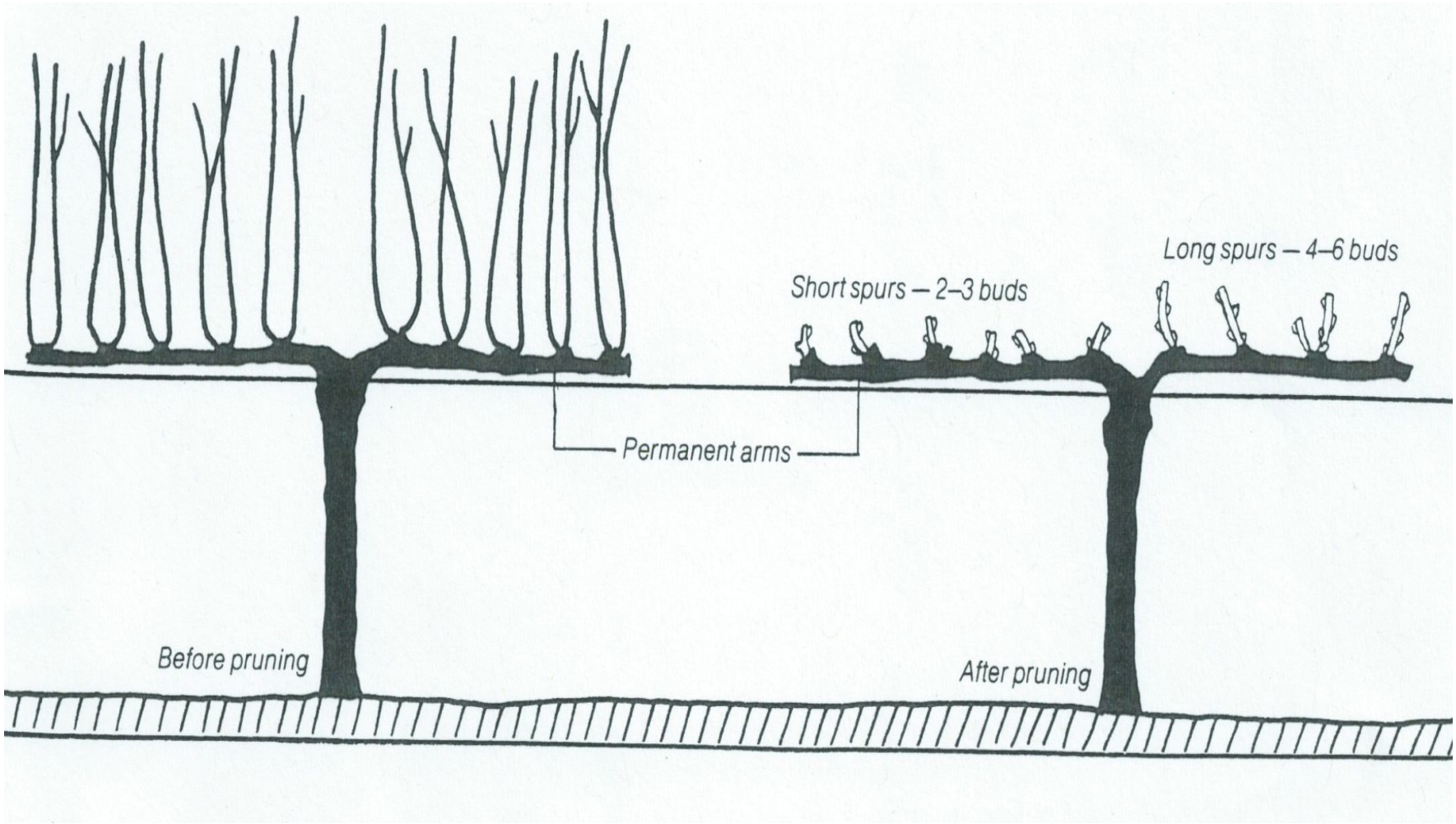
Length of spur is 2 clearly defined buds

Head Trained

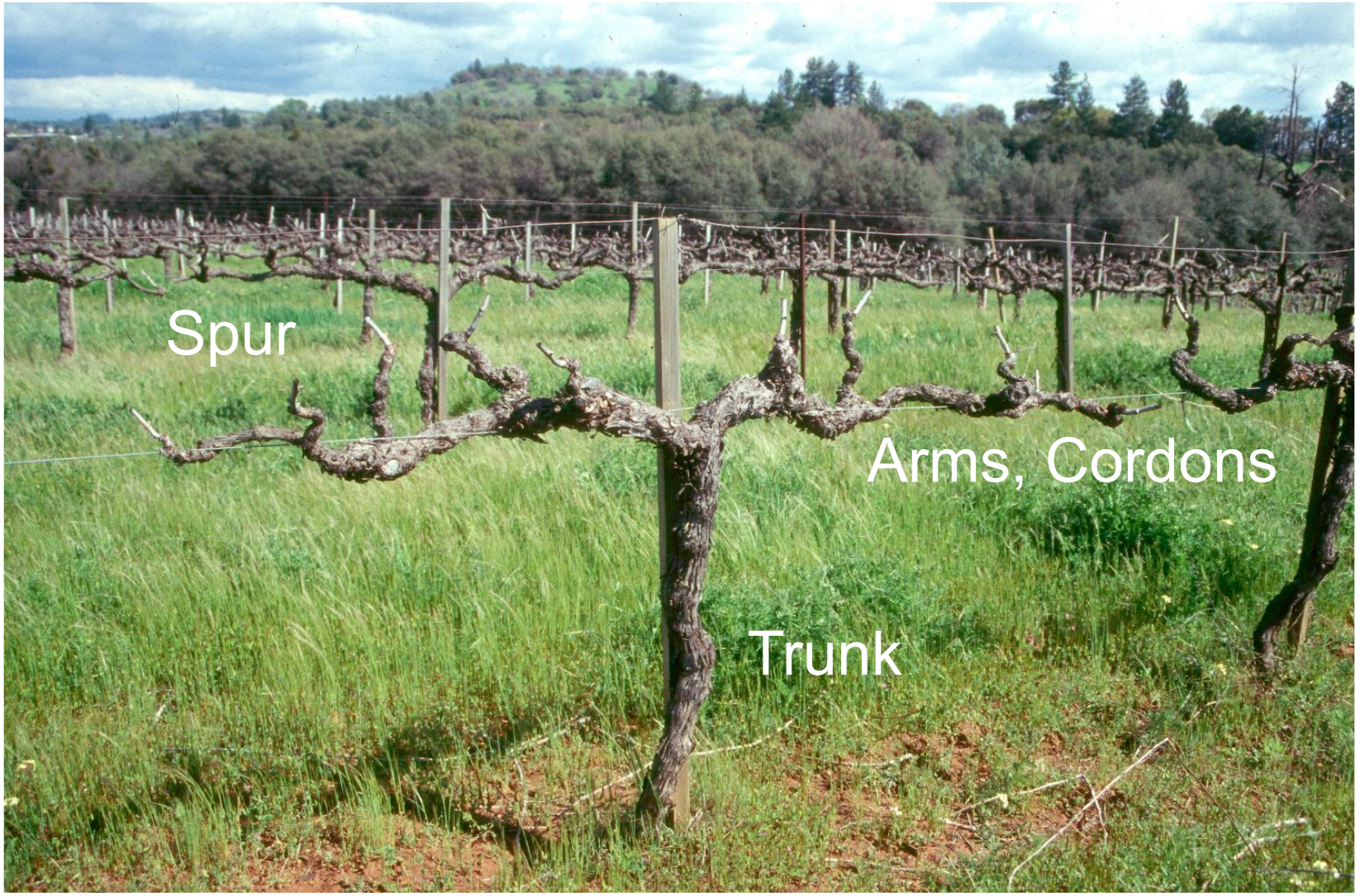
Vine with Spur Pruning



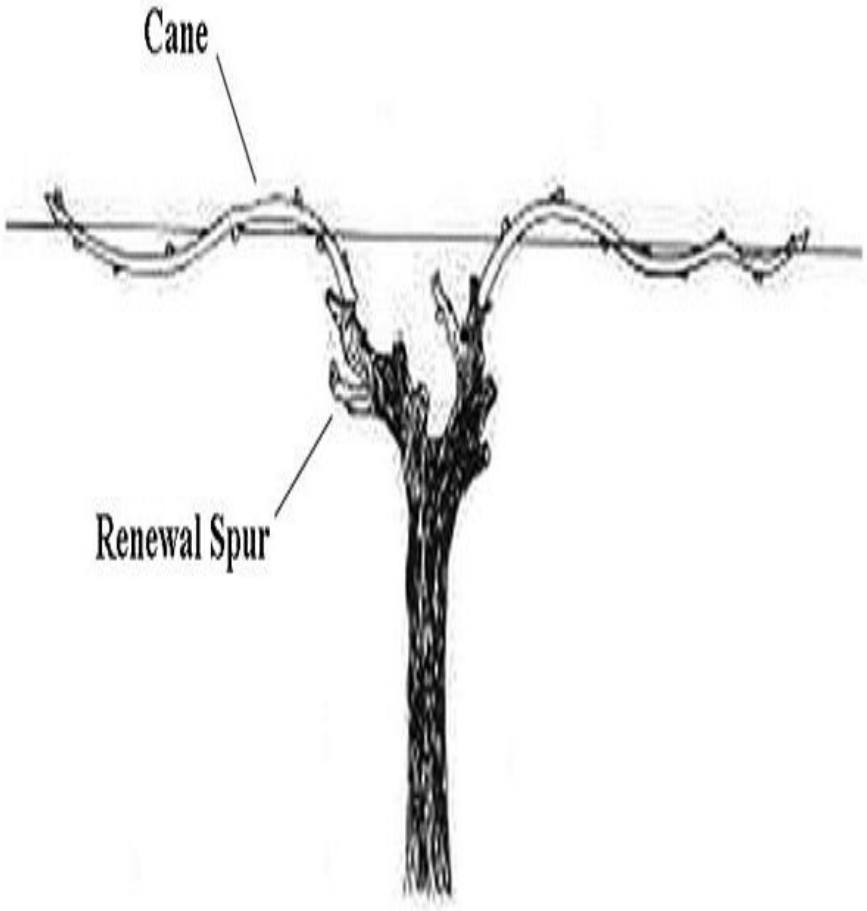
Cordon Pruning



Cordon Pruning



Cane Pruning



Bad Examples

Poor spacing of spurs

No sunlight in canopy
Dead shoots

Wrong Spacing

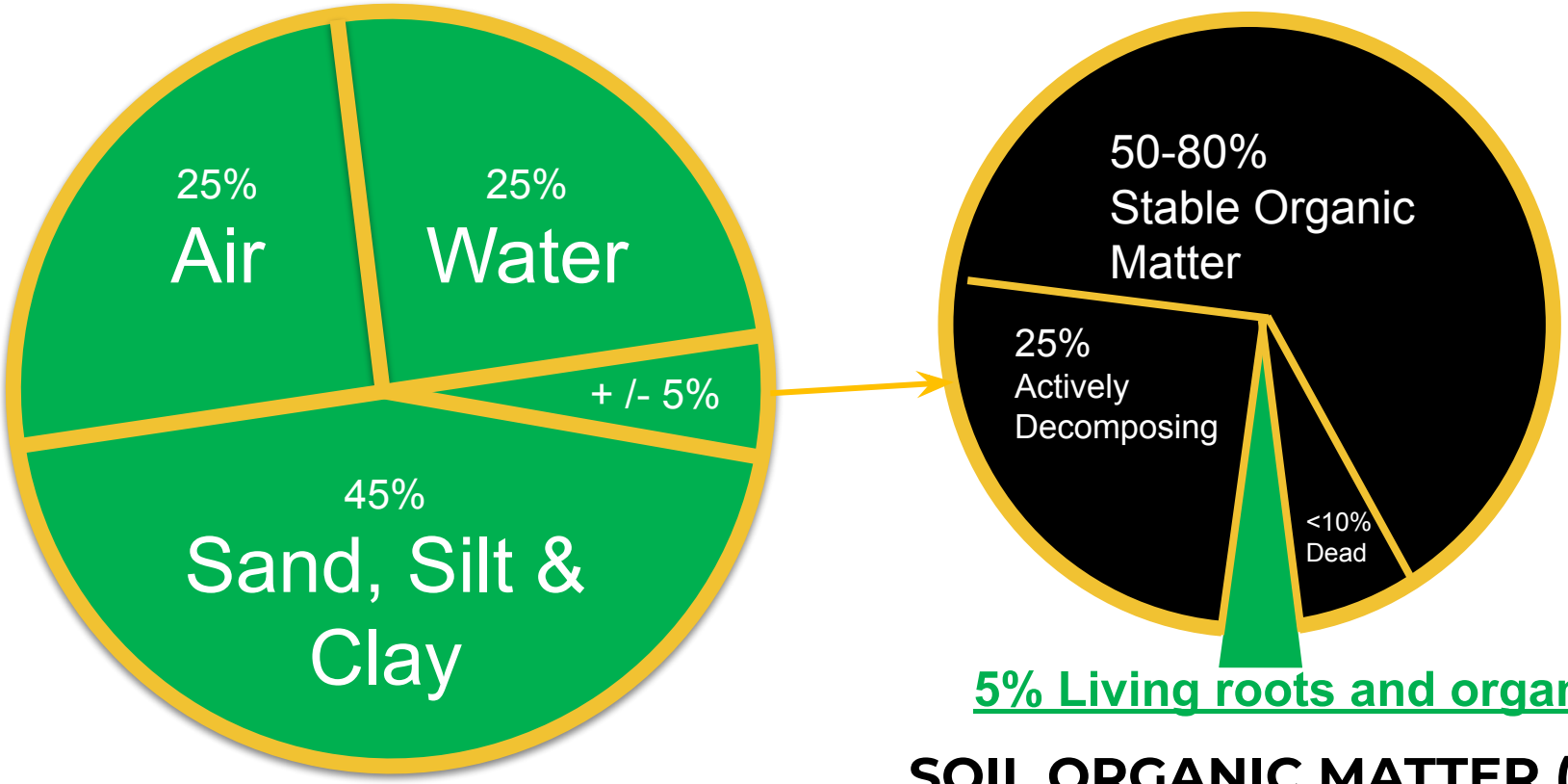
Clusters well spaced

Soil Health

There are more microorganisms in a teaspoon of soil than there are humans on earth.

Soil is the most diverse environment on the planet.

SOIL



SOIL ORGANIC MATTER (SOM)

Simplified Soil Profile

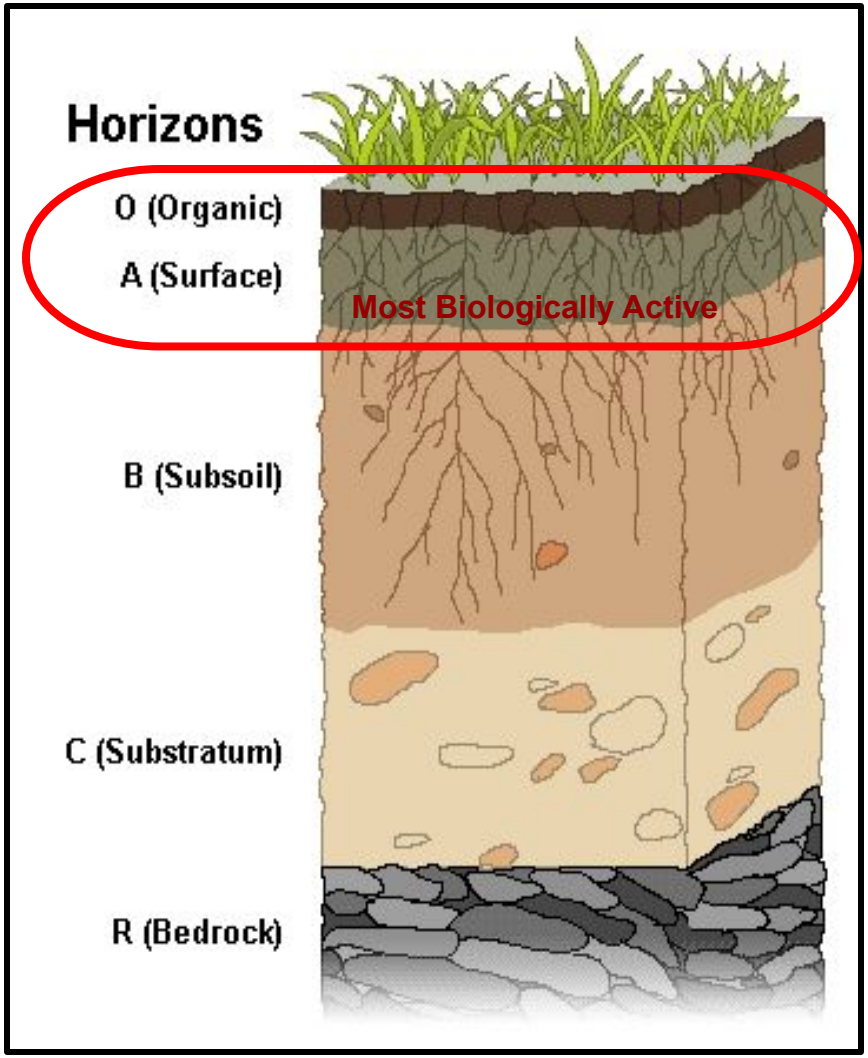
Organic - 2 inches

Surface (Topsoil) - 10 inches

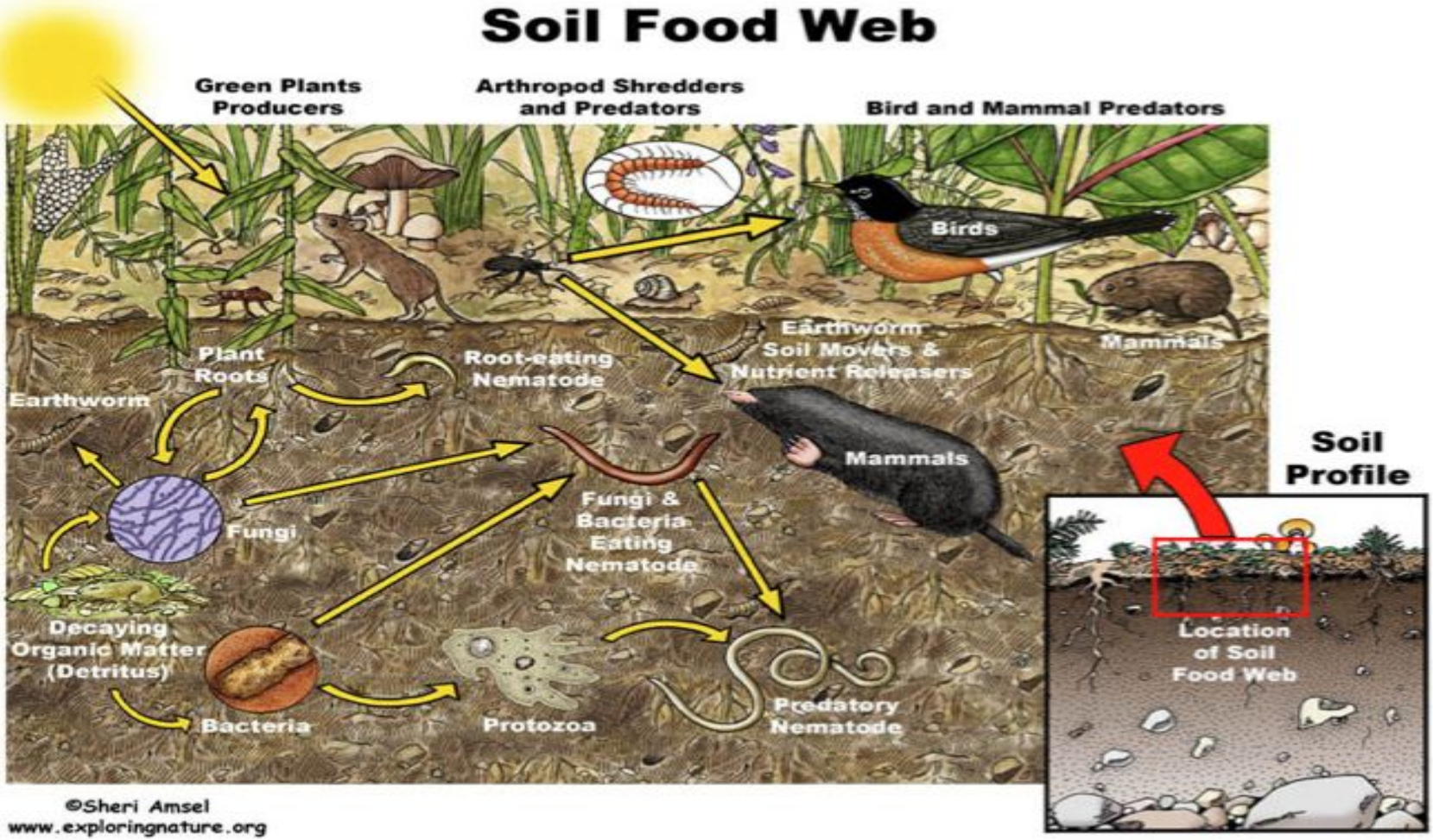
Subsoil - 30 inches

Substratum - 48 inches
(Parent Material - Alluvium, Residual, Colluvium, Marine)

Bedrock



Soil Food Web



Soil Health

- Soil's continued capacity to function as a dynamic, living ecosystem that sustains plants and microorganisms, enhances air and water quality.
- Soil health is the foundation for profitable, productive, sustainable and environmentally sound agriculture.
- Healthy soil is alive with billions of organsims
  - Provides nutrients for plant growth
  - Detoxify potential pollutants, store water
  - Provide habitat for soil communities to diversify, flourish and keep the system running well

Regenerative Farming Practices

Defined as. . .

A holistic land-management practice that uses the power of photosynthesis in plants to sequester carbon in the soil while improving soil health, crop yields, water resilience, and nutrient density.

Regenerative Farming Practices

Minimize Soil Disruption

- Keep soil aggregate intact and fundtional
- Keep carbon, nitrogen and other minerals in the ground
- Protect soil microbiome and the rhizosphere
- Retain healthy topsoil and protect it from erosion
- Keep weed seeds buried deep where they won’t germinate

BASELINE SOIL SAMPLES (% of Total Soil Volume)

Date Sampled: 10/30/20; Location: Las Flores Phase I Baseline			
SAMPLE #	Description	Total Carbon	Nitrogen
1	Planting Area #2 **Rototilled**	2.43%	0.145
2	Planting Area #4 **Not Rototilled**	3.94%	0.246
		-1.51%	-0.10%

One rototilling => Loss of ~38% of Soil's Carbon, ~41% Nitrogen

Keep Soil Covered With Plants

- Use cover crops, crop rotations, compost and animal manures to restore/maintain soil health
- Helps eliminate erosion
- Increase soil organic matter

No Synthetic Chemicals

- Utilizing synthetic chemical fertilizers discourages plants from seeking nutrients deeper in the soil resulting in less carbon sequestration.

- Reduce the use of petroleum products

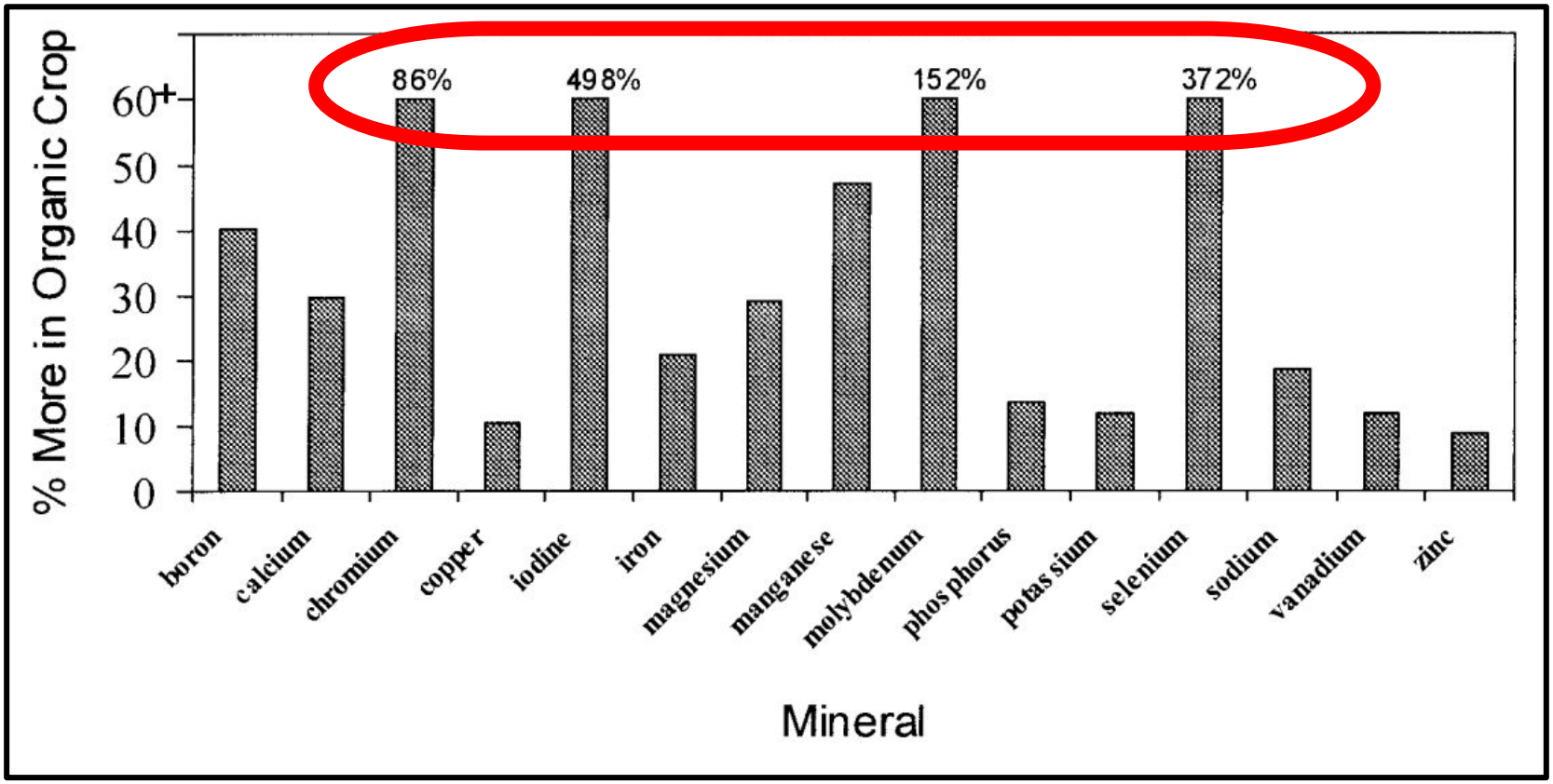
No Synthetic Chemicals

- Utilizing synthetic chemical fertilizers discourages plants from seeking nutrients deeper in the soil resulting in less carbon sequestration.

Borage Plant Root Biomass Test

1	2	3	4
No Amendments No Fertilizer	Synthetic Fertilizer No Compost	Organic Fertilizer No Compost	Compost Amendments No Fertilizer

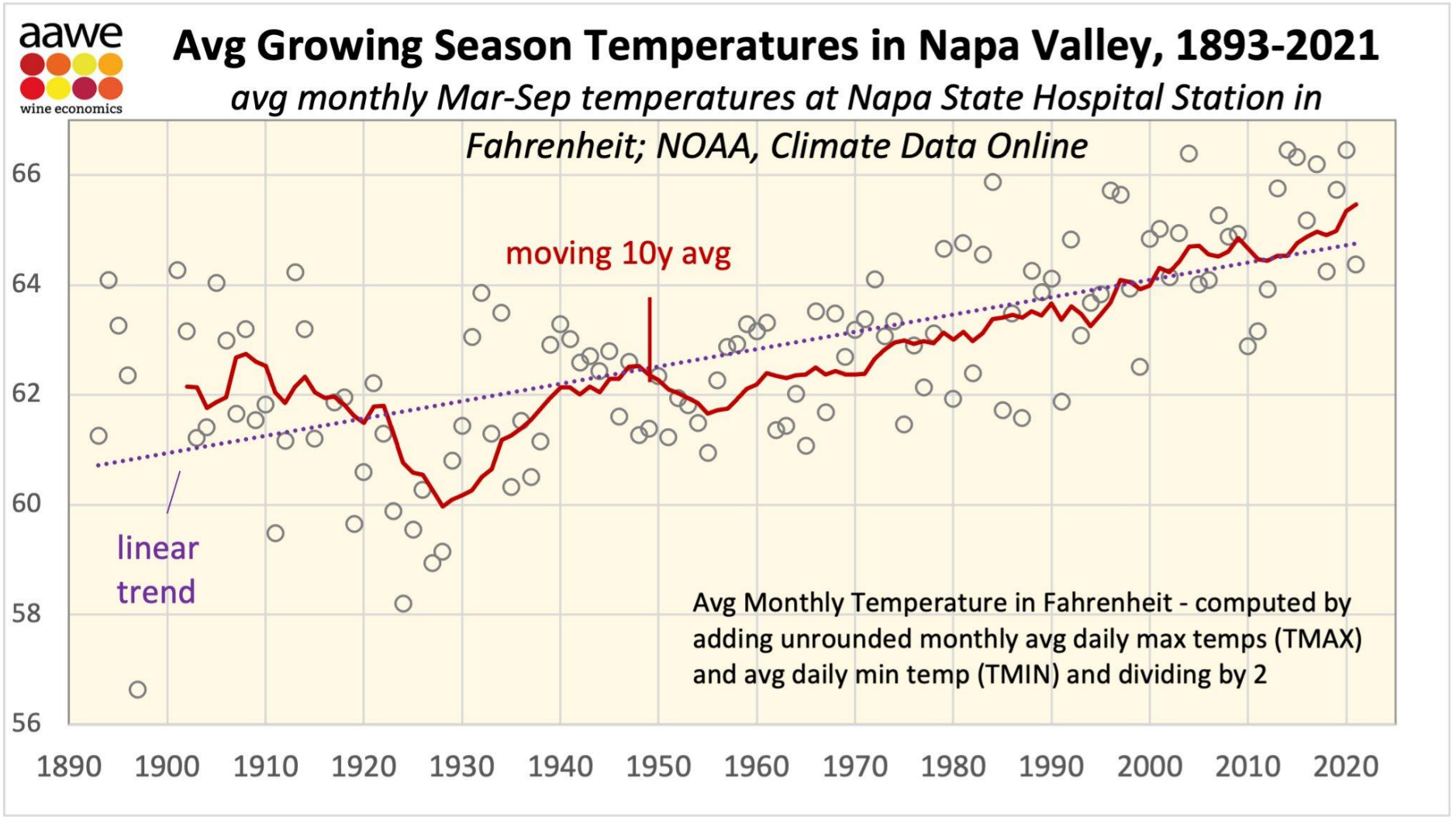
Organically Grown Increased Nutritional Value



Planned Grazing

- Mimics the patterns of animal herds which ensures land is not overgrazed and manure fertilizes the soil and contributes to carbon sequestration.

Climate Change = Extreme Weather Events



Climate Change

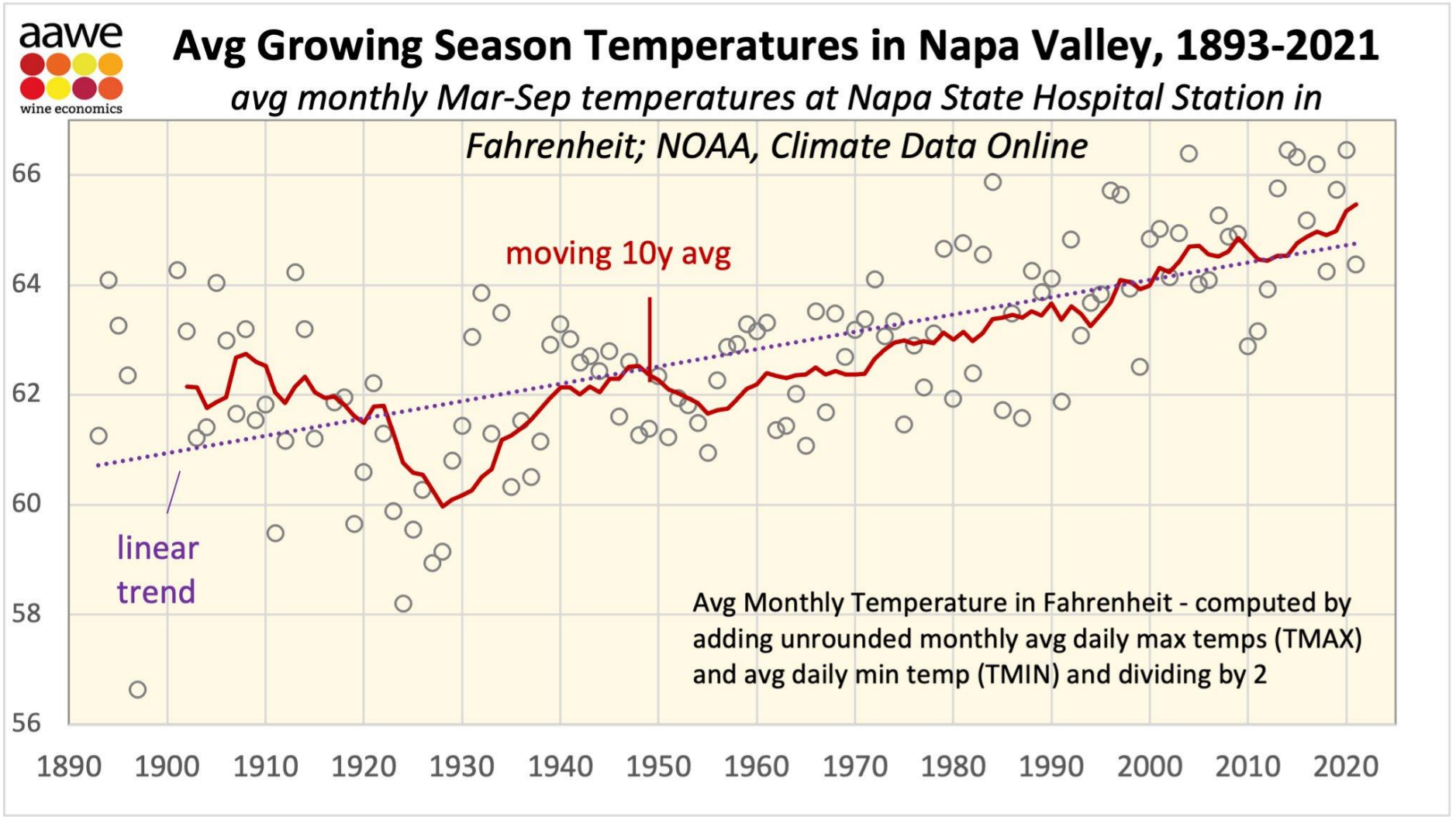
We're at a precipice

Climate Change

Drought

Wildfires

Climate Change



Carbon

Carbon is Essential to Life

Human bodies are made up of 18.5% Carbon

Carbon is food for our trees, plants and soils

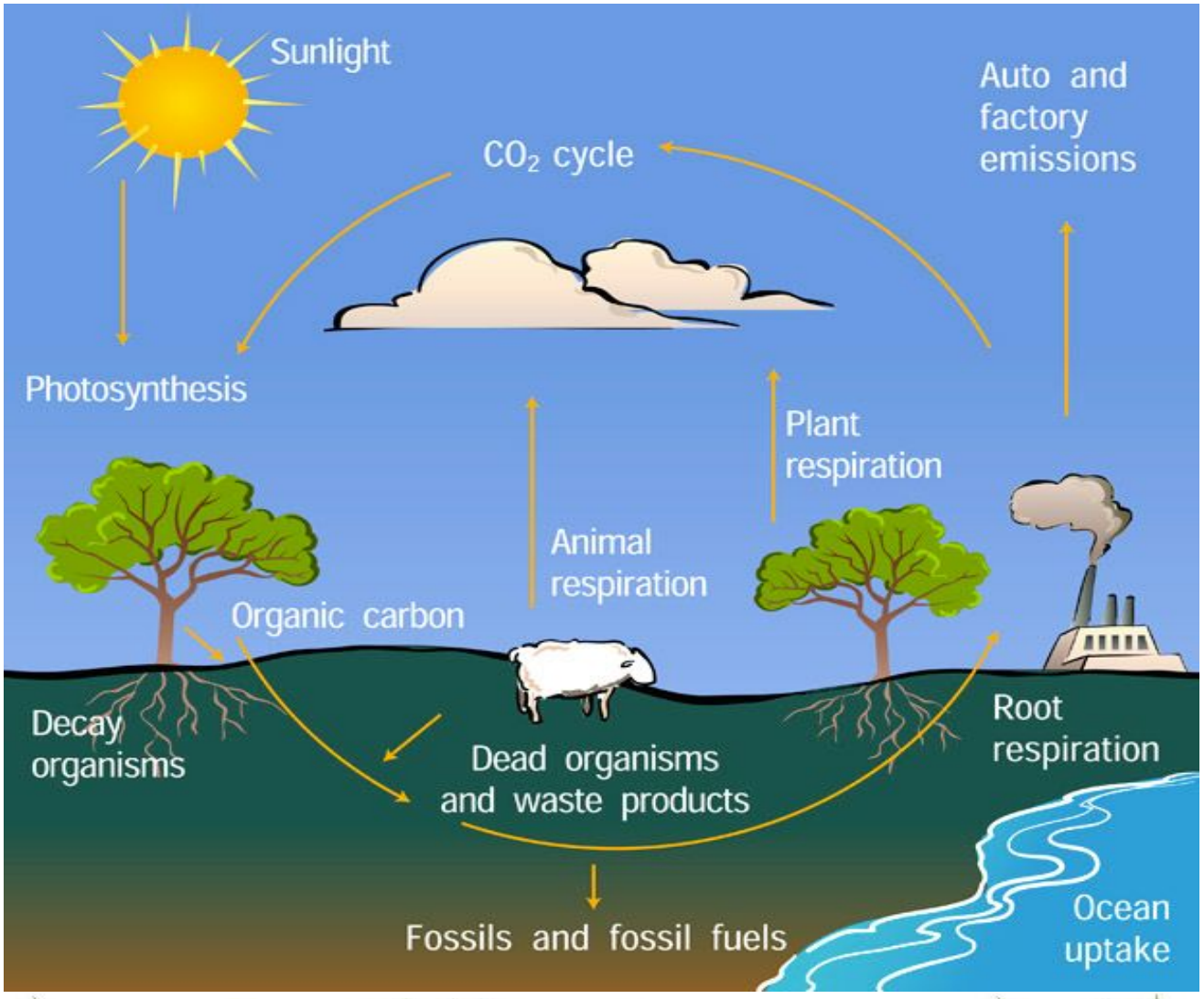
<u>Earth's Carbon Sinks:</u>

> Oceans store 93%

> Soils hold 75%

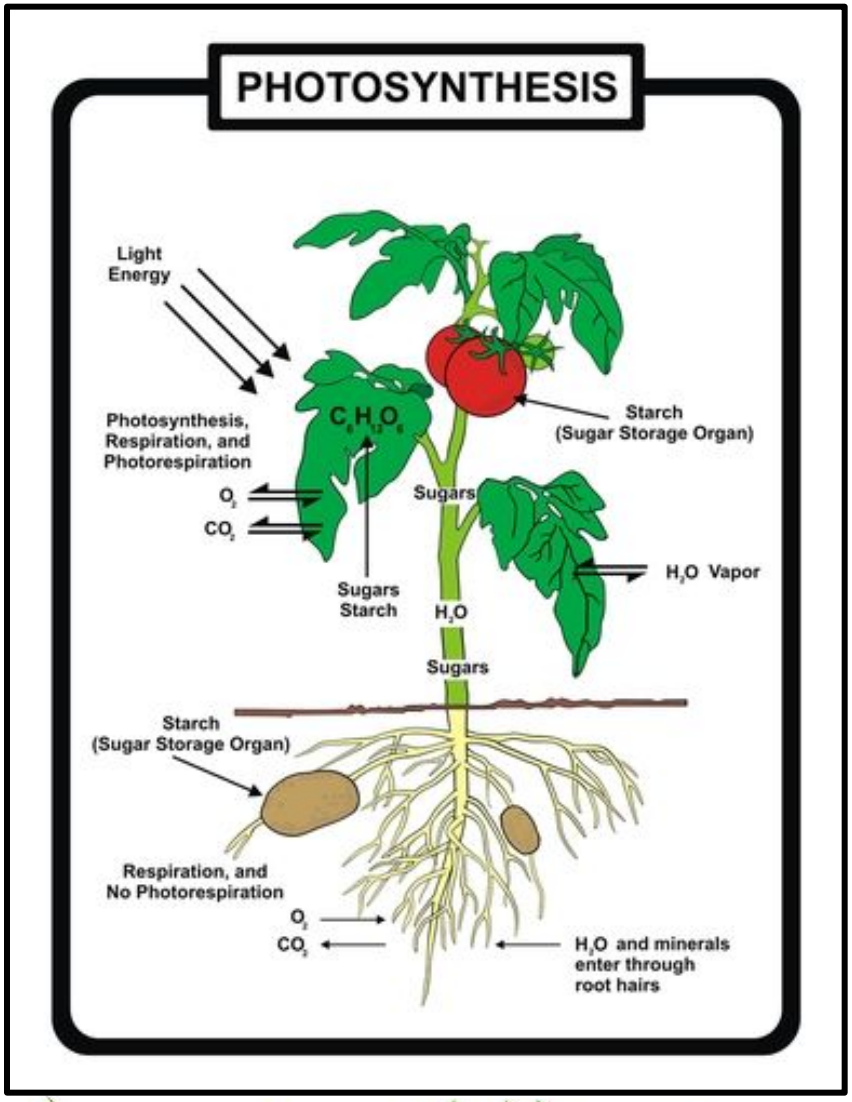
> Trees and plants contain 19%

Global Carbon Cycle



Within our Closed System

Photosynthesis



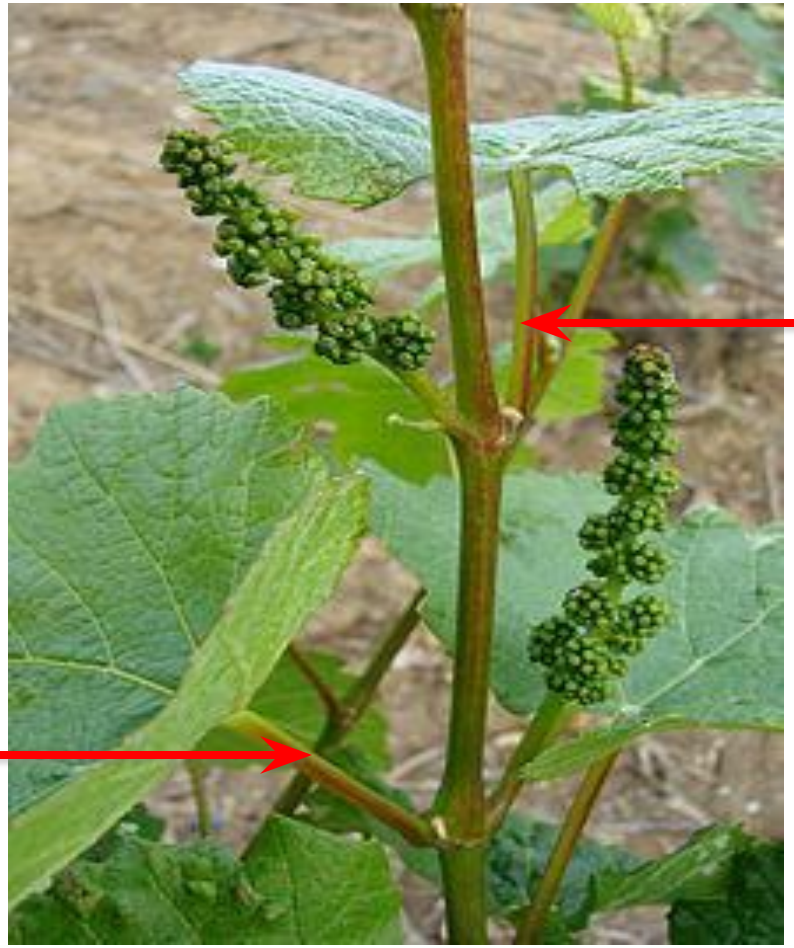
The Process:

- Plant intakes 3 elements: carbon dioxide molecules, light energy and water
- Inside the plant cells, chemical reactions combine these elements
- Energy-rich glucose (sugar) and oxygen gas molecules are formed
- The glucose is stored and the oxygen gas is released into the atmosphere
- Glucose moves into the roots to feed soil microbes that in turn nourish the plant with minerals from the soil
- It's a collaborative exchange underground

Break Time

Petiole Test

- When (At bloom most common)
- Which (Around cluster – opposite)
- How Many (75 – 100)
- Frequency (annually)



Petiole Analysis

Client		Date Sampled	05/11/15
Property		Date Submitted	05/19/15
Project Number	BLOOM 2015	Date Reported	05/27/15

Report of Plant Tissue Analysis

Sampling Date	Lab ID#	Description Block / Variety Rootstock / Growth Stage	N Total Nitrogen %	NO3-N Nitrate Nitrogen ppm	Cl Chloride %	P Total Phosphorus %	K Potassium %	Mg Magnesium %	Ca Calcium %	Na Sodium %	Fe Iron ppm	Al Aluminum ppm	Mn Manganese ppm	B Boron ppm	Cu Copper ppm	Zn Zinc ppm
5/15/15	3	4 / CS 110R / 90% BLOOM	1.01	555	0.13	0.80	2.79	0.62	4.12	0.01	33	18	57	46	8	44
5/11/15	1	1A / CS 3309 / 90% BLOOM	0.89	189	0.26	0.68	3.35	0.79	4.26	0.01	27	13	85	34	8	73
5/11/15	2	1B / CS 3309 / 80% BLOOM	0.95	413	0.27	0.60	3.06	0.83	4.39	0.01	29	20	98	33	7	72
5/11/15	3	2 D-F / ME 3309 / 85% BLOOM	0.92	247	0.32	0.54	3.78	0.76	3.75	0.01	28	19	97	34	7	102
5/15/15	1	2A / CS S04 / 65% BLOOM	0.90	31	0.07	0.50	3.31	0.66	3.78	0.01	34	21	66	37	7	44
5/8/15	1	2B / SB S04 / 80% BLOOM	1.13	107	0.13	0.74	2.72	0.57	3.94	0.01	40	25	147	30	7	56
5/15/15	2	2C / CS S04 / 70% BLOOM	0.85	28	0.11	0.53	2.65	0.62	3.72	0.01	30	21	125	29	6	49
5/8/15	2	2G / CF 3309 / 50% BLOOM	1.03	506	0.33	0.61	4.17	0.80	3.41	0.02	32	15	75	35	7	93
5/6/15	1	2H / CF 3309 / 90% BLOOM	0.95	486	0.35	0.65	3.94	0.51	3.78	0.02	41	31	86	39	6	82
5/6/15	2	3A-1 / CS 3309 / 50% BLOOM	1.03	578	0.28	0.57	2.56	0.67	3.80	0.01	39	26	71	30	7	66
5/8/15	3	3A-2 / CS 3309 / 40% BLOOM	1.09	181	0.30	0.67	2.72	0.58	3.80	0.01	32	20	96	33	6	38
5/6/15	3	3B-1 / PV 420A /	1.45	420	0.15	0.54	2.16	0.54	2.30	0.01	42	25	83	37	6	60
5/6/15	4	3B-2 / PV 3309 / 70% BLOOM	1.30	1014	0.25	0.64	3.65	0.66	2.44	0.01	40	28	65	39	9	72
	Critical levels for Wine Grapes	Deficient	<0.5	<100		<0.15	<1.00	<0.20	<1.0		< 30		<20	<25	< 6	<15
		Marginal	0.5 - 0.75	100 - 200		0.15 - 0.25	1.00 - 1.50	0.20-0.30	1.0-1.5		30-40		20-40	25-40	6 - 8	15-50
		Adequate	0.75 - 1.25	200 - 600		0.25 - 0.60	1.50 - 2.50	0.30-0.80	1.5-2.5	<0.1	40-300	<300	40-500	40-70	8 - 20	50-100
		Elevated	1.25 - 1.50	600- 1000	0.5-0.8	0.60 - 1.0	2.5-3.0	0.80-1.0	2.5-3.5	0.1-0.5		300-500	500-1000	70-150	20-500	100-150
		Excessive	>1.50	> 1000	>0.8	> 1.0	>3.0	>1.0	>3.5	> 0.5		>500	>1000	>150	>500	150+

Grapevine Nutrition

What's Needed for Healthy Growth & Development

Macronutrients

Primary

- Nitrogen
- Phosphorus
- Potassium

Secondary

- Calcium
- Magnesium
- Sulfur

Micronutrients

- Iron
- Manganese
- Molybdenum
- Copper
- Zinc
- Boron

Nutrient Requirements

Five critical questions to ask for proper grapevine nutrition.

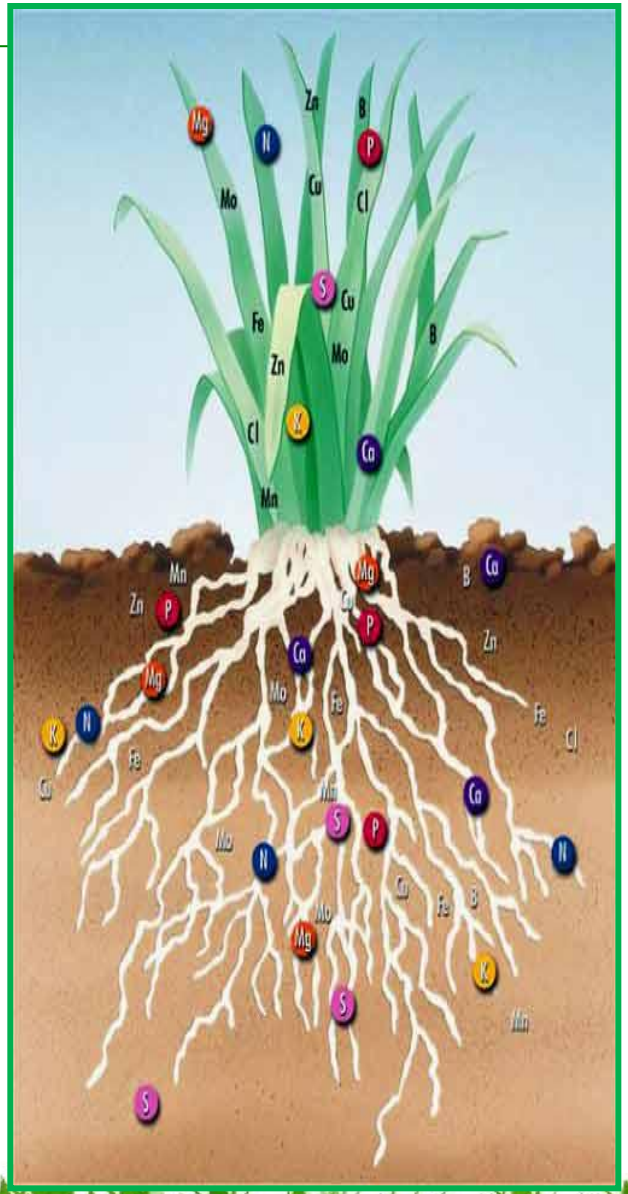
1. Which nutrients are required by the vine?
2. What's the function of each nutrient?
3. At which physiological stage is the nutrient mostly required?
4. When should I fertilize?
5. How much fertilizer should I apply?

When is the Nutrient Required?

Nutrients have different functions and are required during different times of the season.

Most common periods for fertilizer applications are:

- After bud break
- After fruit set
- After harvest
- Foliar applications through the growing season



When is the Nutrient Required?

- Macro elements (N, P, K, Ca, Mg) should be applied to the soil for uptake by roots
- Micro elements (B, Zn, Mn, Fe, etc.) are required in small amounts and can be applied through foliar sprays
- Applications of macro elements should be during periods of active root growth
  - After bud break
  - After harvest
- Applications must be done with irrigation to ensure infiltration to the root zone

All Nutrients are not Created Equal

The Nutrients we *Really* Care About:

- Nitrogen
- Potassium
- Magnesium
- Boron
- Calcium
- Zinc

The Nutrients we *Somewhat* Care About:

- Phosphorus
- Iron
- Manganese
- Molybdenum

Grapevine Nutrition Assessment

Visual - Abnormalities of the plant – trunk, stems, leaves, fruit.

Phosphorus

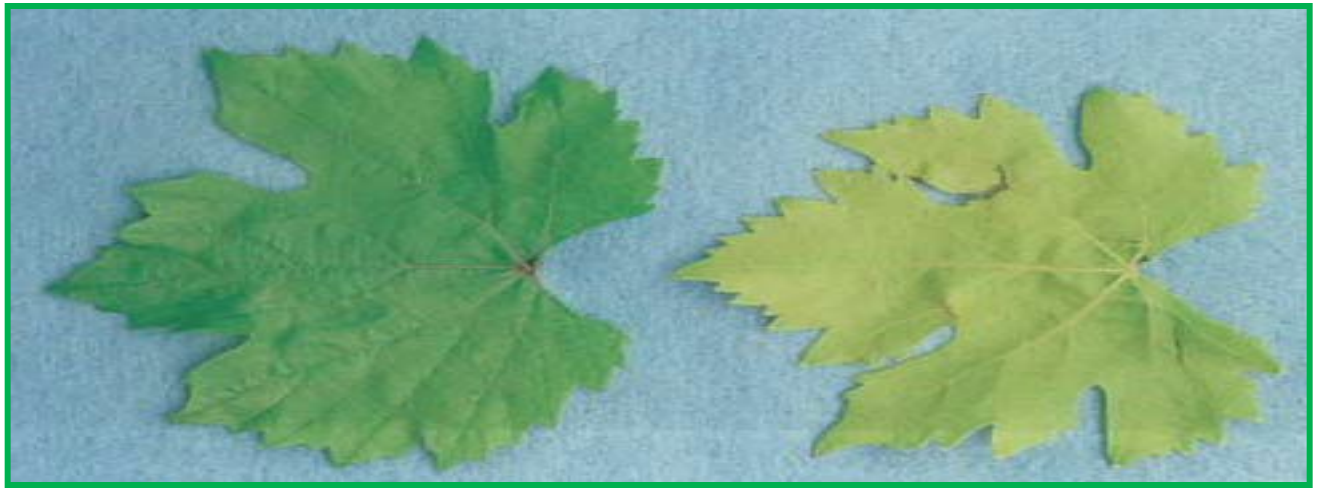
Potassium

Nitrogen

Nitrogen (N)

Too little – pale green color, weak canopy growth, lower yields.

Good Leaf ***Bad Leaf***

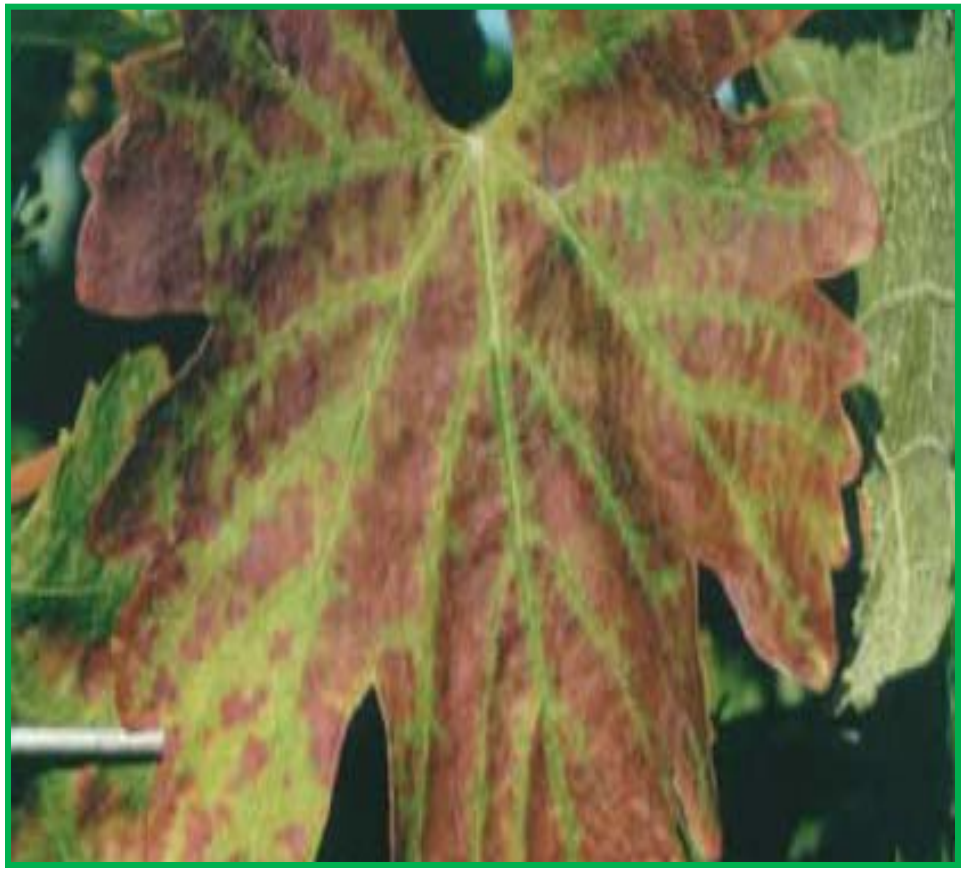


Too much – excessive vigor, fruit shatter, delayed fruit maturity.

Phosphorus (P)

Deficiency: rare in Napa.

Usually found in soils with very low or very high pH or originated from volcanic ash.



Potassium (K)

Deficiency: usually found when grapevines have been heavily cropped.

Shallow, poorly drained soil and water stress contribute.

Boron (B)

- Essential for plant growth and development.
- Small window between deficiency and toxicity.
- Only a small amount is needed (.4 ppm to 1.0 ppm is toxic).
- Deficiencies occur usually in early spring drought or later in the season with a soil deficiency.
- Toxicities can occur in Napa as we have high levels in soil & water.

Deficiency

Toxicity

Calcium (Ca)

- Important in organs (shoots, leaves, roots), especially leaves
- Constituent in cell membranes, permeability of cell membranes
- Important for survival during dormant period
- Strength of berry skins

Zinc (Zn)

- Essential for plant protein synthesis, the production of some plant hormones and in pollination and fruit set.
- Deficiency causes distortion of leaves as well as interveinal chlorosis.

Fertilization Guidelines

- Before applying an ounce of fertilizer STOP and ask “why am I doing this?”
- There is no recipe for nutrition management.
- Low to moderate fertility can improve wine quality.
- Multiple applications are better than a single large one.
- Soil treatments are usually more durable than foliar.
- Foliar feed micronutrients and soil treat the macronutrients
- Most fertilizers, soil and foliar, are best applied between fruit set and veraison, with the exception of Boron and Zinc.
- Don’t pollute. Manage nutrients as you would pesticide.

Fertilization Calendar

December, January & February

- Apply boron spray to soil beneath vines if petiole analysis indicates need.
- Apply zinc sulfate to vine cuts if there are indications of need.

March, April & May

- Mow cover crops
- Apply pre-bloom zinc and boron foliar spray. Usually mixed with wettable sulfur.
- Send petiole samples to laboratory for tissue analysis.

June, July & August

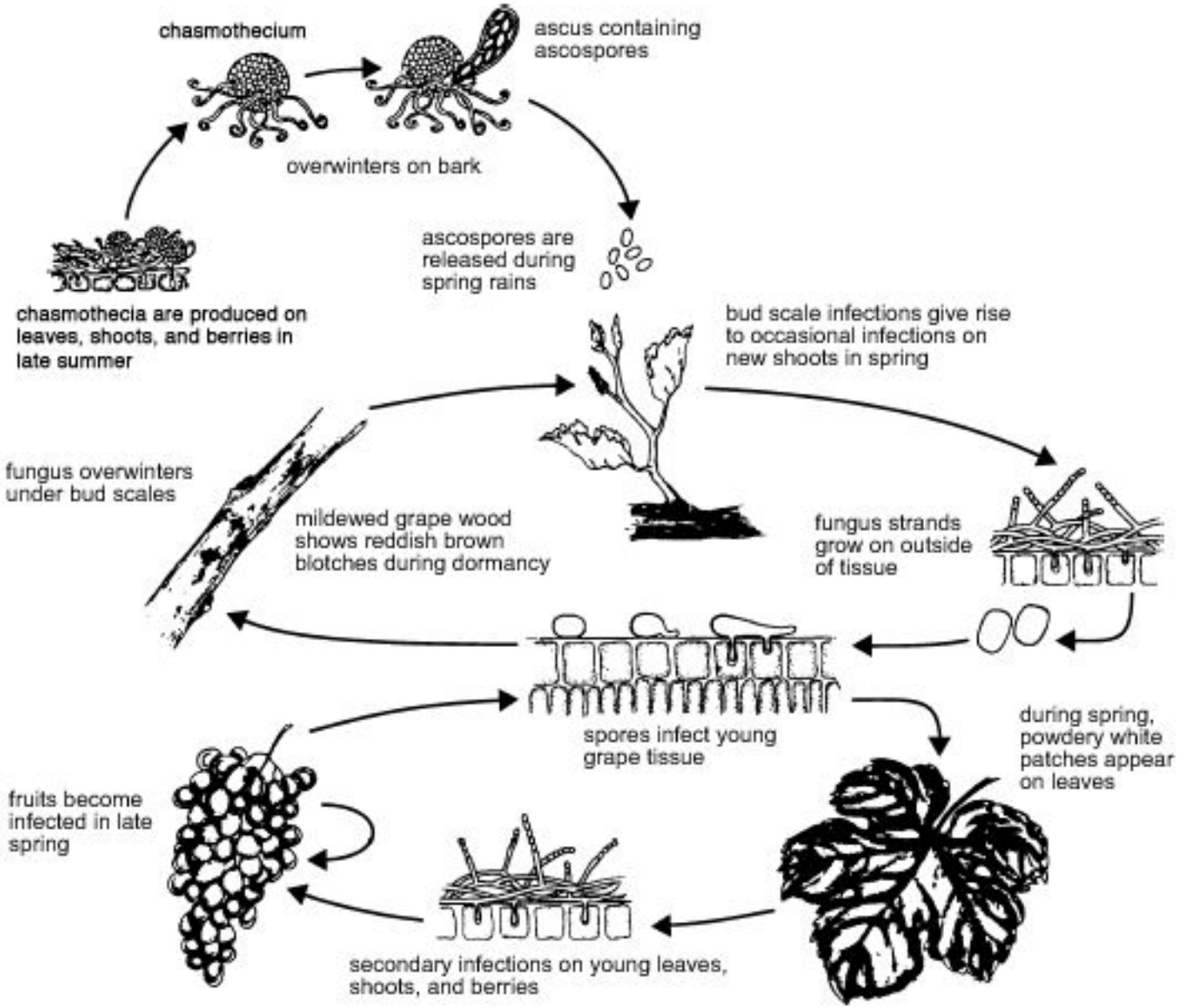
- Apply potassium sulfate, if petiole test shows need.
- Apply organic fertilizer or compost directly beneath drip emitters after bloom.

Integrated Pest Management

Powdery Mildew

Uncinula necator

POWDERY MILDEW DISEASE CYCLE


chasmothecium
ascus containing ascospores
overwinters on bark
ascospores are released during spring rains
chasmothecia are produced on leaves, shoots, and berries in late summer
bud scale infections give rise to occasional infections on new shoots in spring
fungus overwinters under bud scales
mildewed grape wood shows reddish brown blotches during dormancy
fungus strands grow on outside of tissue
spores infect young grape tissue
during spring, powdery white patches appear on leaves
fruits become infected in late spring
secondary infections on young leaves, shoots, and berries

Initial Infection

Powdery Mildew

Heavy Mildew Infection

Powdery Mildew

Figure 21.8 Scarring on canes resulting from shoot infection

Management

FUNGICIDES

- Sulfur – actually a protectant, won't kill an active infection but prevents new infection.
- Oils – kills fungal colonies (includes horticultural oils (i.e.: Saf-T-Side Spray Oil, Neem oil, Jojoba oil etc.)
- Synthetic Fungicides
- Other – biologicals, etc. (i.e.: Serenade)

CULTURAL PRACTICES

- Adequate trellis system/training
- Shoot thinning/leaf removal
- Appropriate hedging

When Do You Spray?

Commercial/Sophisticated Approach:

- UC Davis Powdery Mildew Risk Index Model
- Weather Station

Small Home Vineyard Empirical Approach:

- Start spraying at bud break/continue approx. every 2 weeks until grapes get to 12 Brix. Vary interval by temp/humidity.

Spray Residue/Damage

Integrated Pest Management (IPM)

- Prevention
  - Correct plant in correct place
  - Maintain tree & garden health (correct watering, fertilization, pruning, and sanitation; balanced eco-system)
- Minimize and Target Intervention

Vine Mealybug

Vine mealybug, Planococcus ficus, honeydew and white wax on infested grapevine after mechanical harvest. *Photo by Larry L. Strand.*

Grape mealybug

Grape, Obscure, and Vine Mealybug

Figure II. Reddish orange fluid excreted by grape mealybug (photo: JKC).

Figure III. Clear fluid excreted by obscure mealybug (photo: Kent M. Daane).

Figure IV. Vine mealybug colony in the axils of the petiole and cane (photo: Mark Battany).

Leafroll

Redblotch

Sharpshooters

Sharpshooters

Pierce's Disease

Mites


UC Statewide IPM Project
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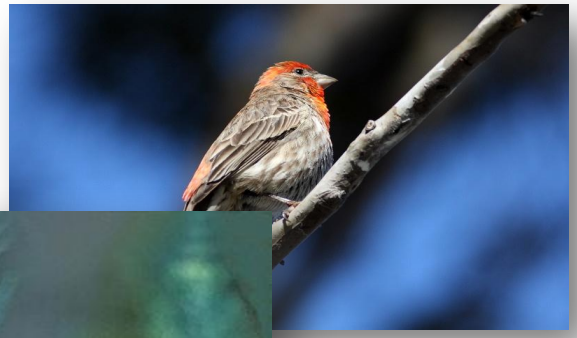
Eutypa

Vertebrate Pests

- Birds
  - COVER THE AREA



Vertebrate pests

- MANAGEMENT
  - Protective Netting
  - Frightening Devices
  - Shooting
  - Trapping
  - Repellents

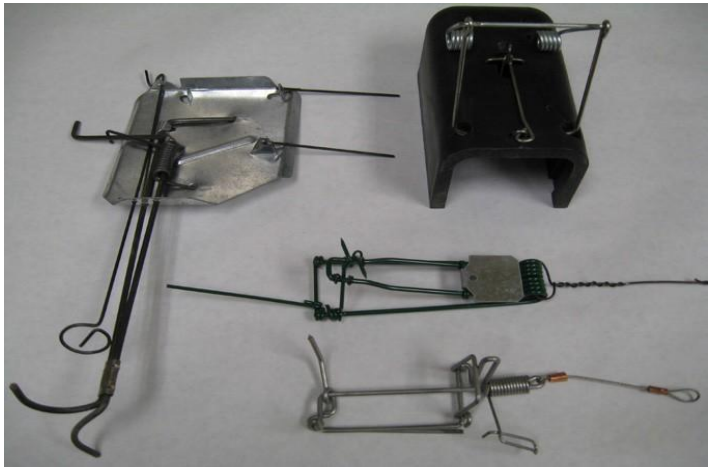
Vertebrate pests

- Deer Proof the area with chicken wire on the ground

Gophers

Adult pocket gopher, Thomo-mys species.

Top view of a pocket gopher mound



Types and brands of gopher traps include (clockwise from upper right) Victor Black Box, Macabee, Go- phinator, and Cinch.

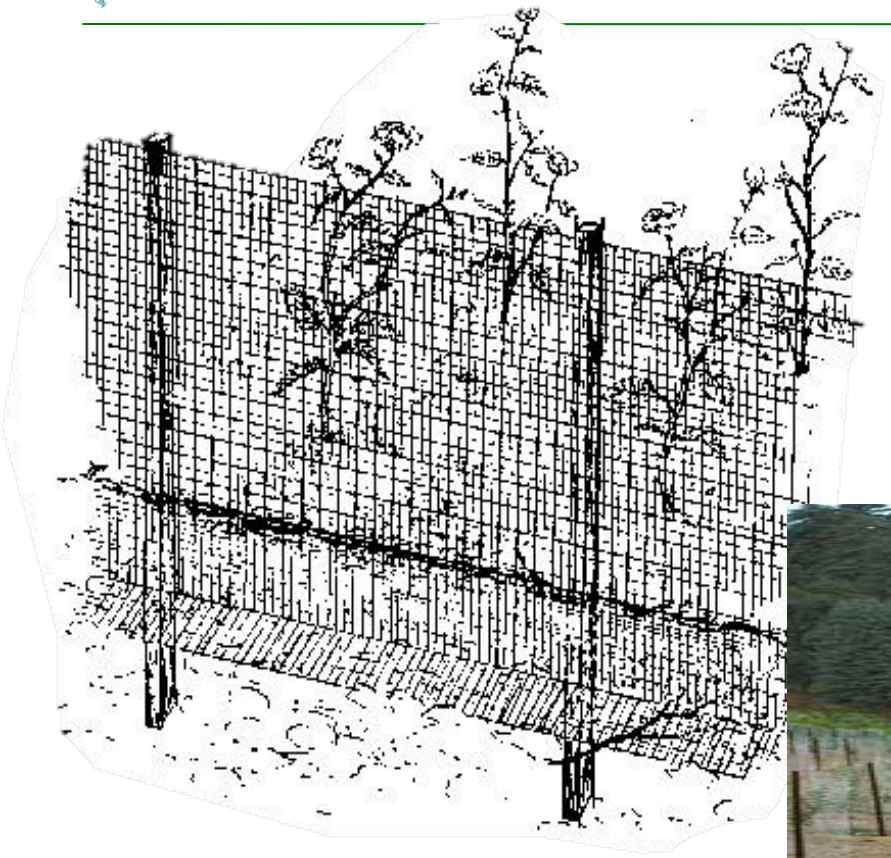
Top view of a mole mound.

Vertebrate Pests - Rabbits

- Jack
  - Prefer open to semi open area
  - 3 – 7 pounds
  - Long black-tipped ears
  - Breed: Jan – August
    - 2–3/each litter
    - 5 litters/year

- Cottontail
  - Prefer dense cover, bushy areas
  - 1 ½ - 3 pounds
  - Rounded shape
  - Breed: Dec – June
    - 3 – 4 /each litter
    - 6 litters/year

Vertebrate Pests

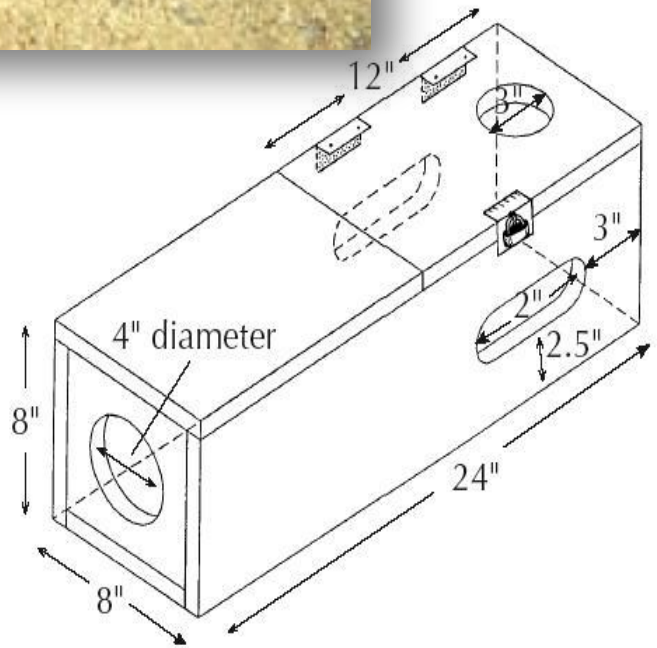


- Rabbit Management
  - Rabbit-resistant plants
  - Exclusion
    - Fencing
    - Trunk Guards

Vertebrate Pests

- Rabbit Management
  - Trapping (cottontails)
    - Box plus conibear trap

  - Rabbit Repellents
    - Chemical with unpleasant taste
    - Application before damage
      - Reapply often
      - Not for plants intended for human consumption



VOLE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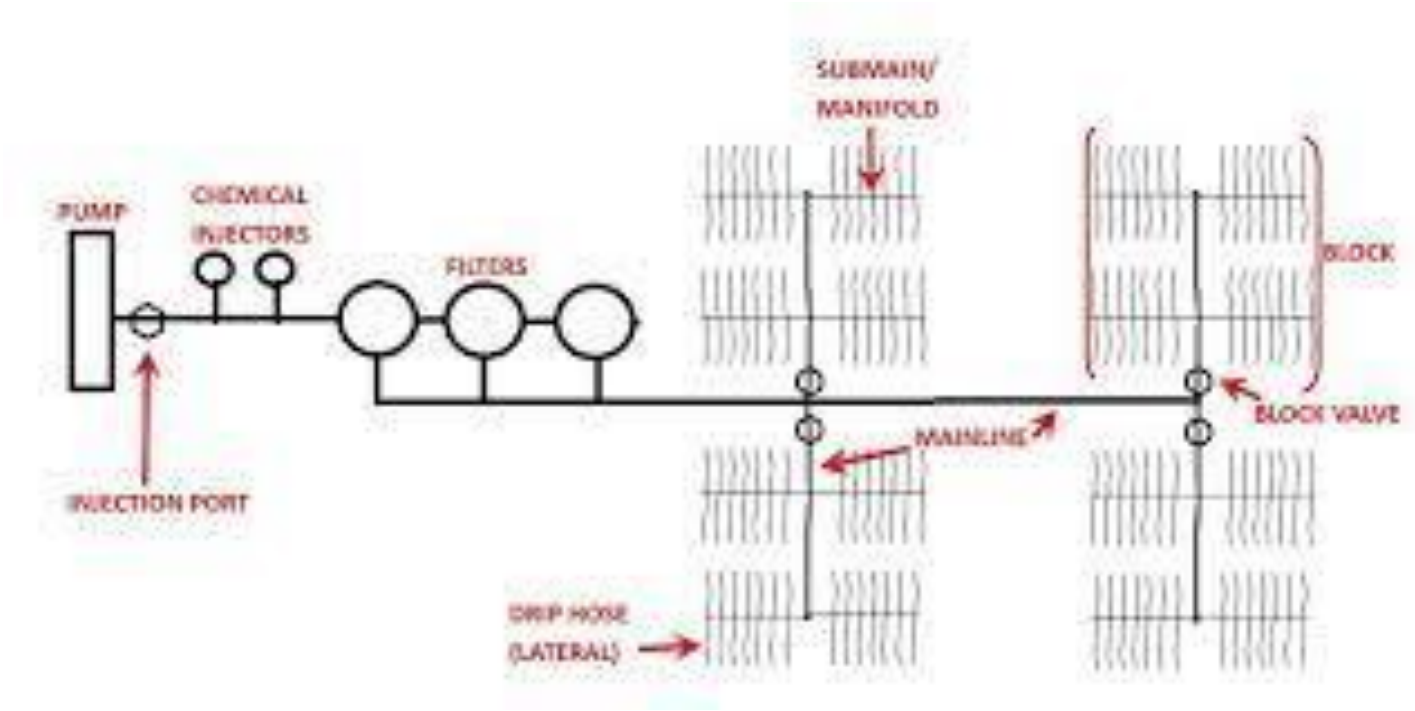
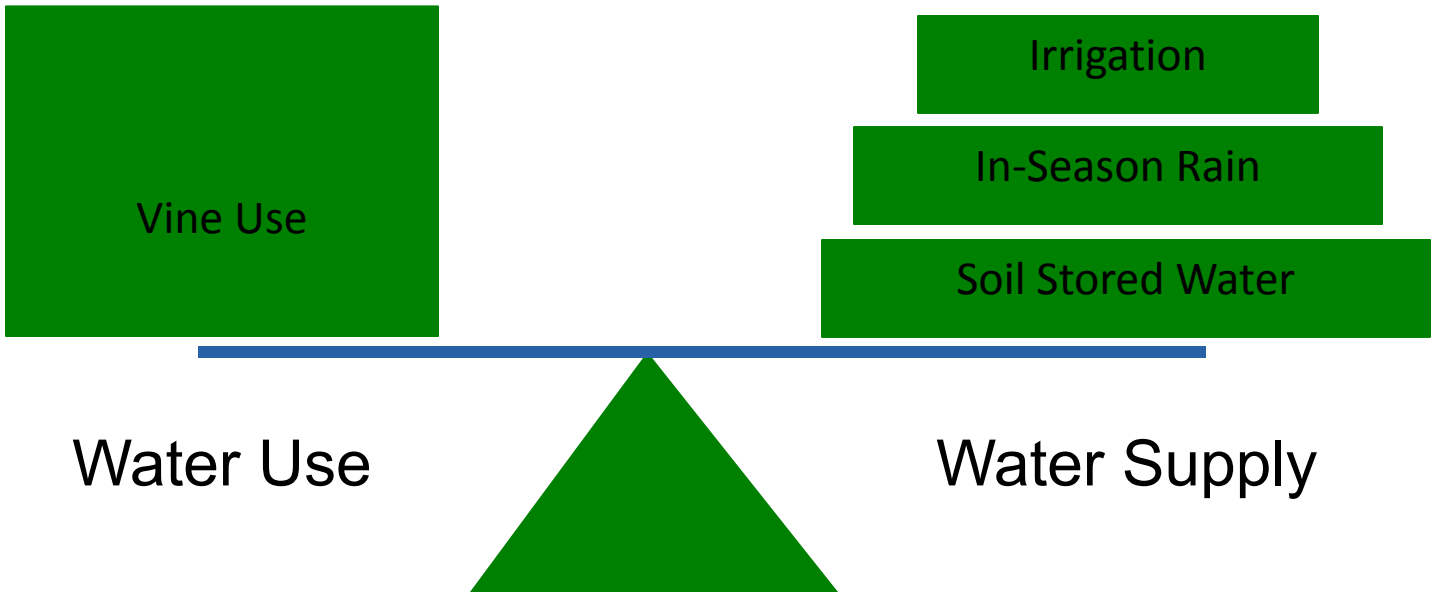
VOLE DAMAGE- girdled trunk

Irrigation

Scheduling and Maintenance



When and How Much



Vine Water Use

Transpiration = water loss by plants through their stomata.

Evaporation = Water loss from the leaf surface

Evapotranspiration relates to the rate of water use. It includes the evaporation of water from the soil surface and the movement of water from the soil through the plant and out through the leaves.

Vines are drought resistant plants. Water only when necessary.

The best thing is to know your plants: make visual assessments

When To Begin

During rapid shoot growth

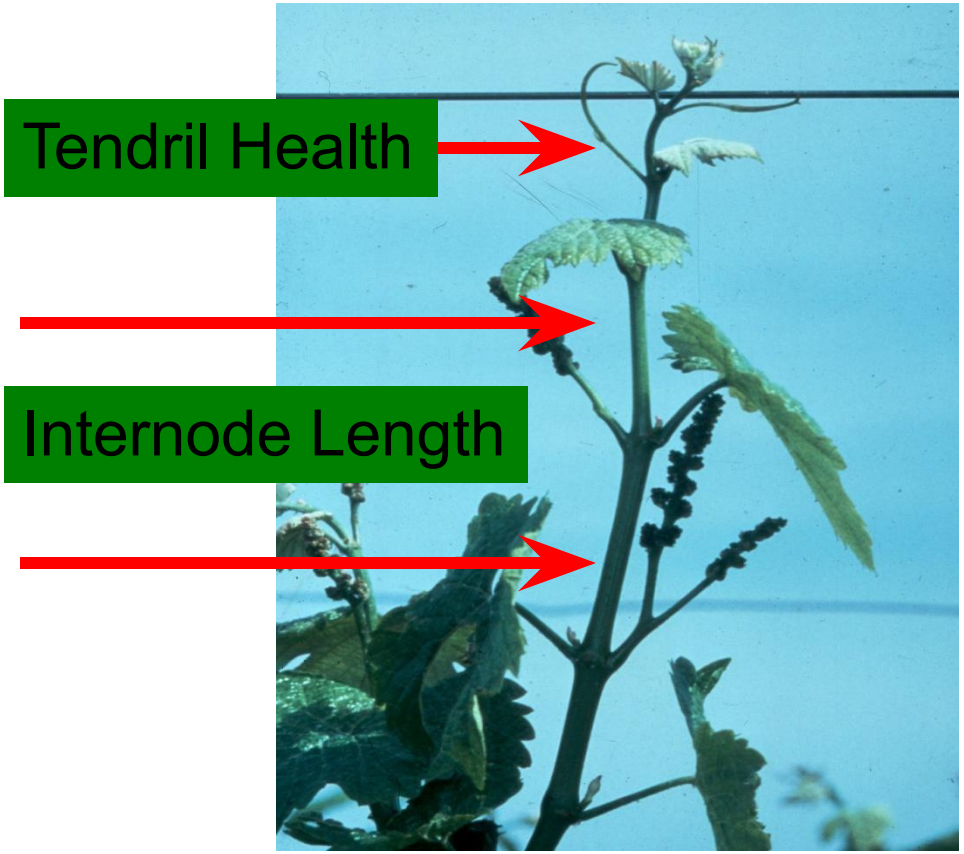
Growing Season

Shoot Length influenced by water deficits

Shoot tip condition

Test Soil Moisture

Visual Assessments



How Much?

Know your microclimate

- Each vineyard can be very different in location (climate), soil-water capacity, vigor and trellis design.

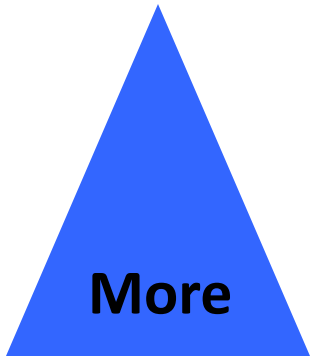
Production Goals

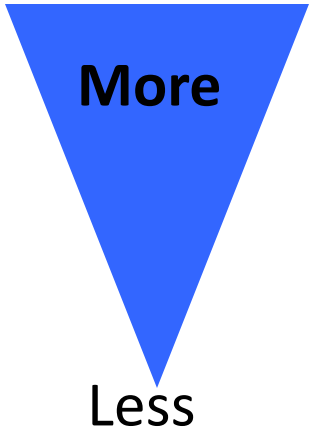
- Variety and wine program to which the fruit is destined.

Know your soil

Soil Texture affects water-storage capacity

Textures	Holding Capacity	Irrigation Needs
Sandy	Less	More
Loamy		
Clayey	More	Less





How Much?

New Vines – First Year

Soil Type	First Six Weeks	Second Six Weeks	Remainder of Season
Sandy	1.5 Gals/per Day	1.5 Gals/2nd Day	1.5 Gals/3rd Day
Loamy	1 Gal/ per Day	1 Gal/2nd Day	1 Gal/3rd Day
Clayey	.75 Gal/per Day	.75 Gal/2nd Day	.75 Gal/3rd Day

How Much?

New Vines – Second Year

Soil Type	June 1* - Six Weeks	July 15th until October
Sandy	1.5 Gals/3rd Day	2.5 Gals/5th Day
Loamy	1 Gal/3rd Day	2 Gal/5th Day
Clayey	.75 Gal/3rd Day	1.5 Gal/5th Day

* Start time can vary based on rainfall

When?

Scheduling

- It depends on:
  - the weather
  - the soil
  - the spacing
  - the rootstock . . .

When?

Bloom to Veraison

- Irrigate as needed to continue development of canopy
- Active growth slows down approaching verasion

Veraison to Harvest

- Irrigate to maintain canopy, but not encourage growth
- Too much water can deprive roots of oxygen
- Encourages bunch rot give a vegetate flavor to the fruit from too much canopy

Finding Balance

Excessive shoot growth recognized by:

- Large leaves
- Long internodes
- Excessive lateral shoot growth

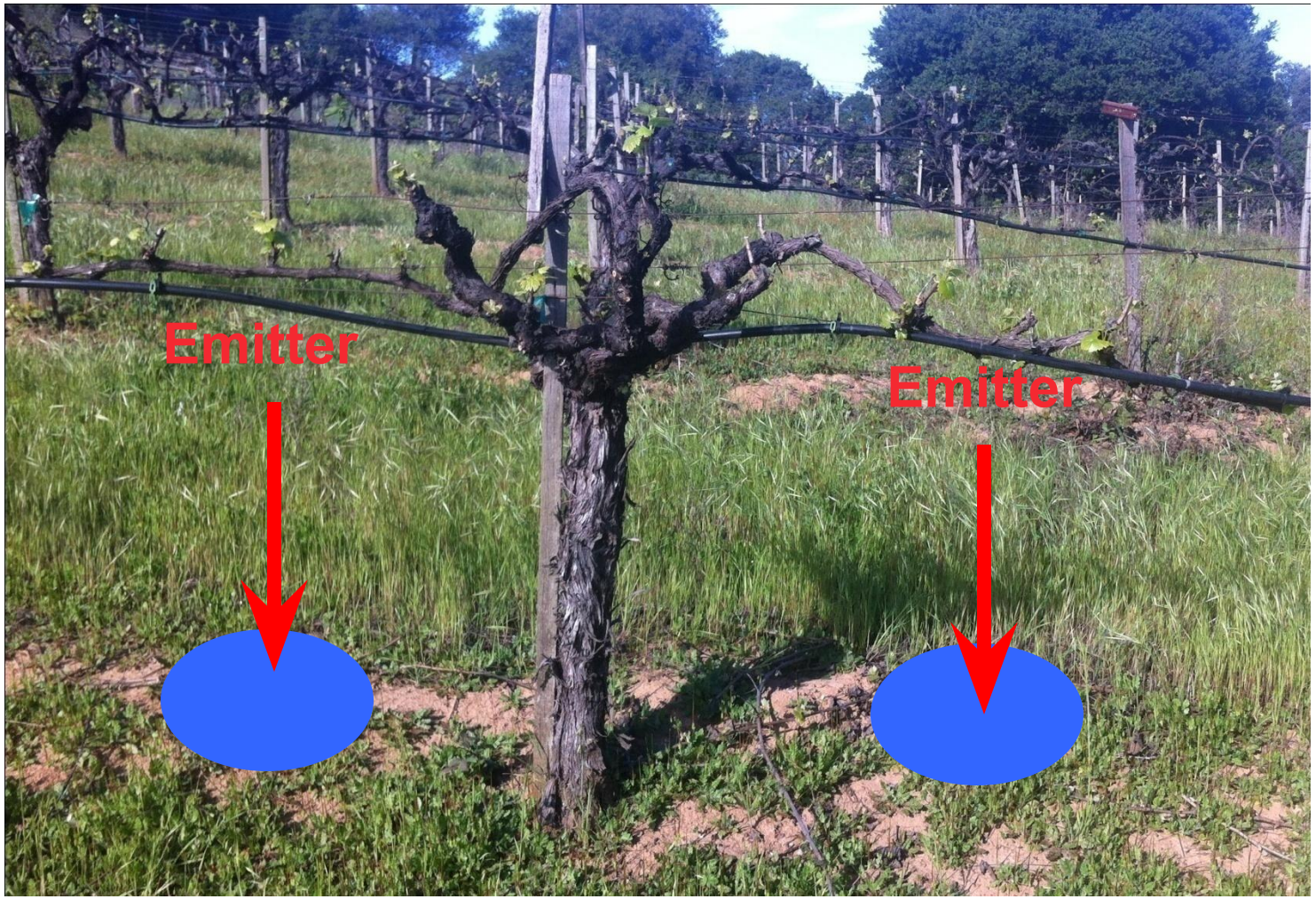
But – watch weather conditions, dig to determine moisture soil levels

- Don't overly stress vines
  - –shriveling and yield reduction
- Consider watering to "hang" the fruit until harvest ripeness

Post Harvest

- Irrigate to maintain the foliage for carbohydrate accumulation during the fall.
- 4-8 hours. Drip irrigation
- DO NOT water when plants are dormant

Where - Established Vine



Where - Young Vine

Do not stress new vines

Drought & Dry Farming

- We may need to start prior to bloom
- Check soil moisture levels now
- May need to adjust crop load to available water
- Dry Farming assumes rain!
- Dry farming is typically implemented over a number of years after vines are established