

# Paul Vossen

UC Cooperative Extension

Sonoma County

133 Aviation Blvd., Suite 109

Santa Rosa, CA 95403



**Precision Small-Scale  
Farming Equipment  
Workshop  
May 21 - 2015**





SRJC Farm

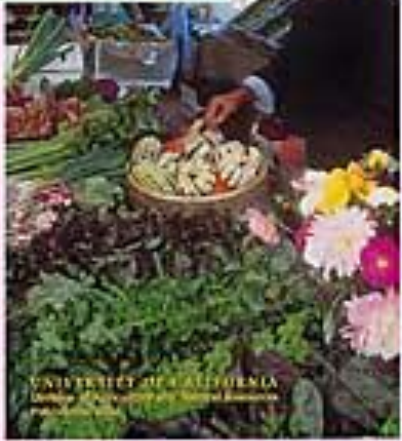
**University of California  
Cooperative Extension**

**Research  
and  
Education**

# Written Materials

## Specialty and Minor Crops Handbook

Second Edition



## California Master Gardener Handbook

David R. Pittenger  
Editor



University of California  
Agriculture and Natural Resources  
Publication 3301

## Organic Vegetable Production Manual

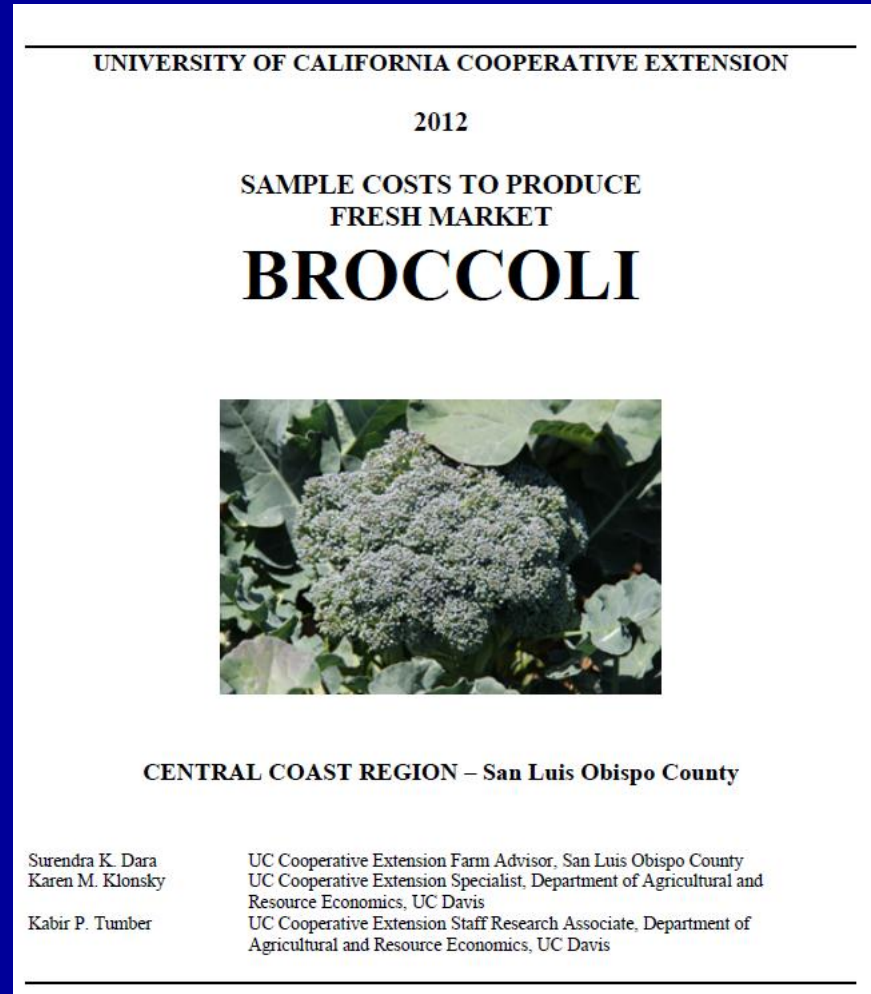
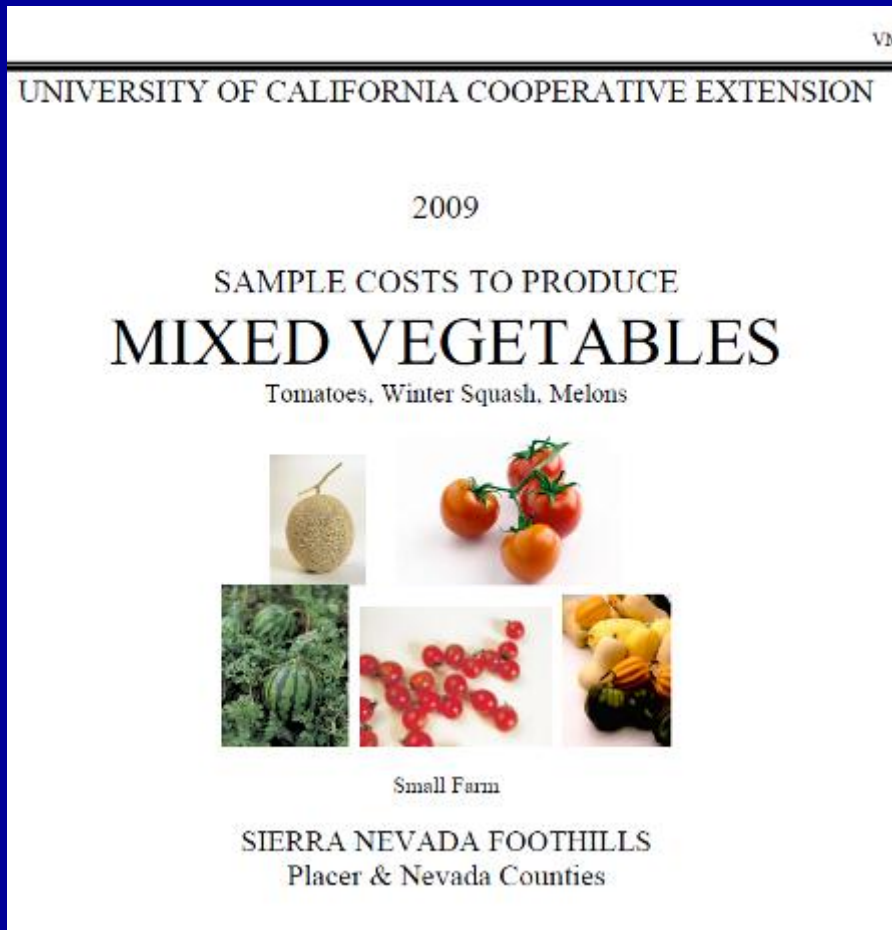
Technical Editor  
Milton E. McGiffen, Jr.

Publication Coordinators  
Jeri Ohmart and David Chaney

University of California  
Agriculture and Natural Resources

Publication 3509

# UC Cost Studies



# More Information

## <http://vric.ucdavis.edu/>

The screenshot shows a web browser window displaying the UC Vegetable Research & Information Center website. The browser's address bar shows the URL <http://vric.ucdavis.edu/>. The website features a header with a collage of vegetable images and the title "Vegetable Research & Information Center" in a stylized font, followed by "University of California Cooperative Extension".

**Mission of the Vegetable Research and Information Center**

VRIC's mission is to foster appropriate research, collect and disseminate information relevant to consumers, growers and processors in the California vegetable industry and to continue its role as a leader and nationally recognized source of research and information in support of the vegetable industry.

**Contact us**


**Address:**  
UC Vegetable Research & Information Center  
Dept. of Plant Sciences, Mailstop 4  
One Shields Avenue  
Davis, CA 95616

**Phone:** (530) 752-1740 **Fax:** (530) 752-4604 **Email:** [vruc@ucdavis.edu](mailto:vruc@ucdavis.edu)

**New Items**

by	Salinas Valley Agriculture ELOS
event	Overhead Irrigation and Conservation Tillage Twilight Field Tour and BBQ, June 10, 2010 : 5-9 PM
event	Kern County Potato Variety Trial Field Day : June 16, 2010 : 10 AM-1 PM <b>"NEW"</b>
documents	Disorders and defect in head lettuce
documents	Update of research on tomato powdery mildew control programs (part 2) : May 2010
articles	UC Farm Business and Market Place
articles	UC Nutrient Management for Vegetable, Fruit and Nut Crops

**Did you Know...?**



California is the salad bowl of America, providing a year-around supply of lettuce, celery, broccoli and cauliflower.

**In this Section**

- Home
- About VRIC
- Calendar
- Continuing education
- Events
- FAQs
- How-to's
- Resources
- Vegetable information
- Virtual tour

**Items of Special Interest**

- ANR catalog
- Backyard Orchard
- Food Safety & Good Agricultural Practices
- Home gardening
- Postharvest

**VRIC Members Only**

- UC3 Web Group

Search ANR & California Agriculture Magazine


Google Search Results  Only

Search VRIC

Division of Agriculture and Natural Resources, University of California.  
All contents copyright © 2010 The Regents of the University of California. All Rights Reserved.  
Development funding from the University of California and USDA - CSREES.  
Please email your comments to: [vruc@ucdavis.edu](mailto:vruc@ucdavis.edu)  
Last updated: June 1, 2010. Web site design by: Luan Bunkhara

**UCDAVIS**  
DEPARTMENT OF PLANT SCIENCES

**University of California**  
Agriculture and Natural Resources



Print Page

# Many Choices

- **Fruit Trees**
- **Grapes**
- **Christmas Trees**
- **Berries**
- **Vegetables**
- **Cut Flowers**
- **Herbs**



# Mission Impossible Without Water



# Making it Less Bad

- Save as much soil moisture as possible
- Increase OM content of soil – over time
- Irrigate responsibly – don't waste water
- Manage deficit irrigation – timing
- Select & time crops that use less water
- Mulch
- No weeds

## Drought Management



# *Rainfall from Mother Nature*

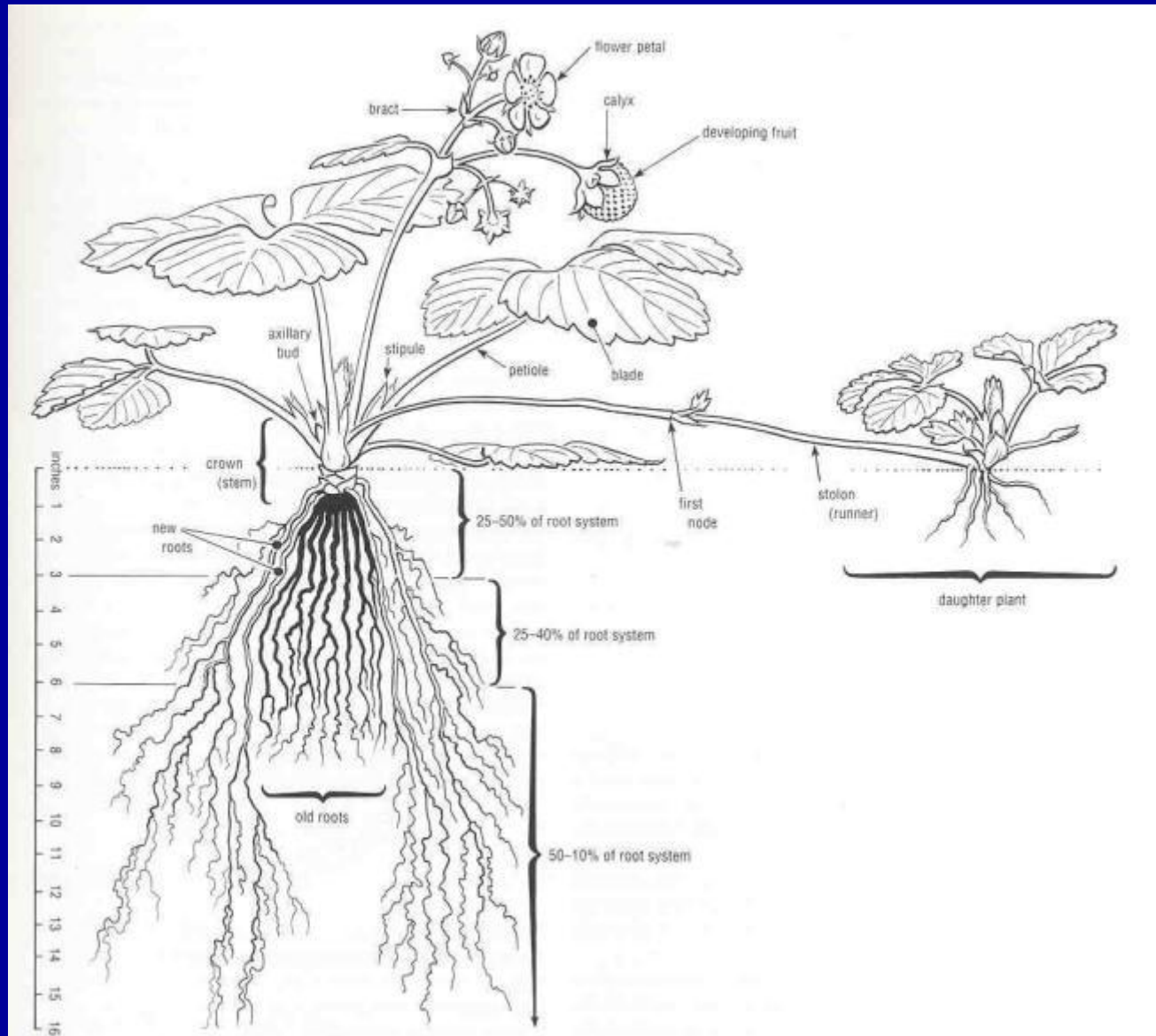
*Rainfall 20 – 90” per year*

*Most of it runs off*

## Soil Water Holding Capacity

- Clay = 2.0 to 2.5 inches per foot
- Loam = 1.5 to 2.0 inches per foot
- Sand = 1.0 to 1.5 inches per foot

# Soil – Root - Profiles



**Vegies  
and  
Berries  
are in  
the top  
1 foot  
= 2''**

# Preserving as much rainfall soil-stored moisture as possible

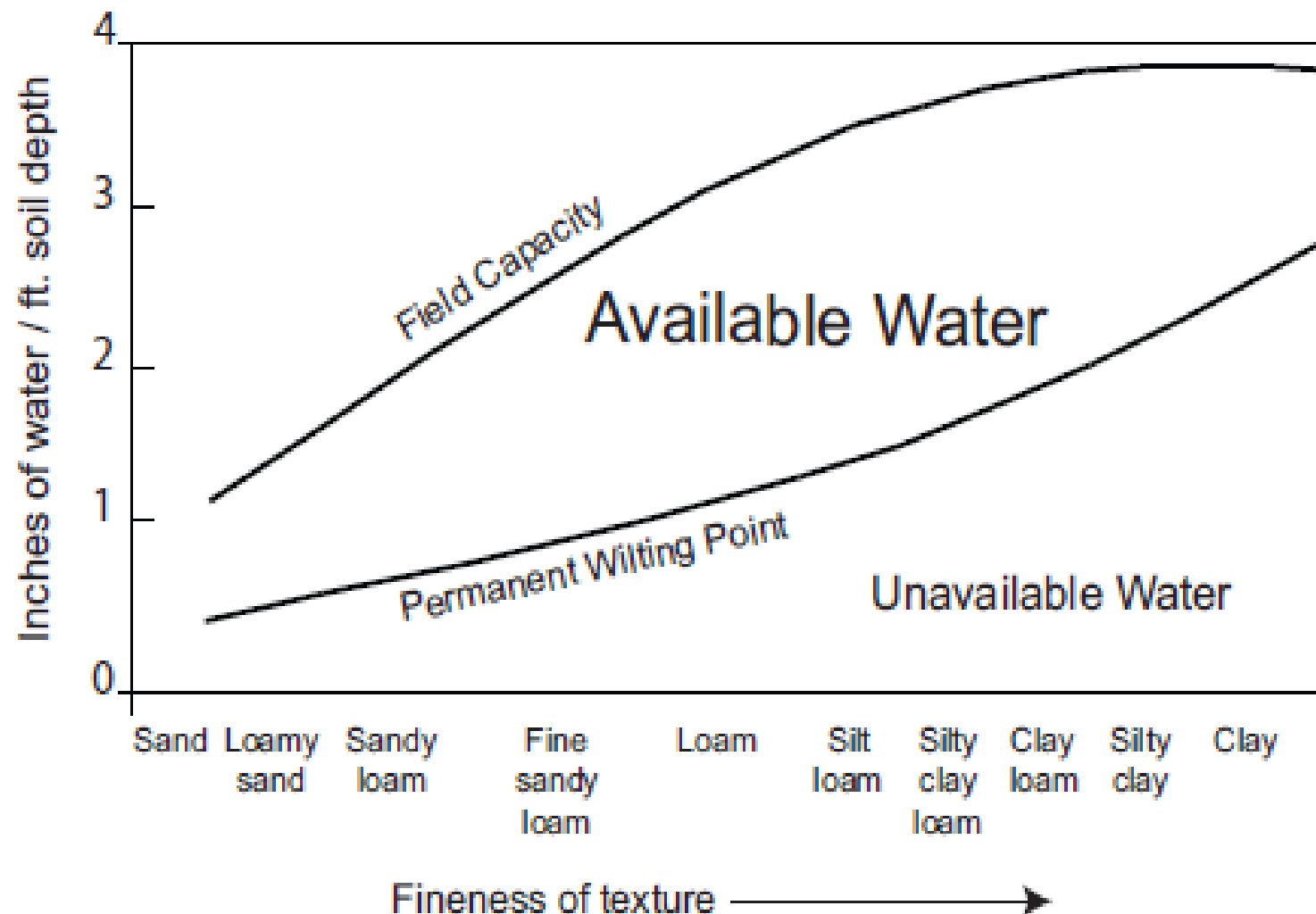
- No weeds
- No cover crop
- Mulch
- Herbicide
- Cultivate
- Add OM
- At least - keep weeds short



# Cover crops use water

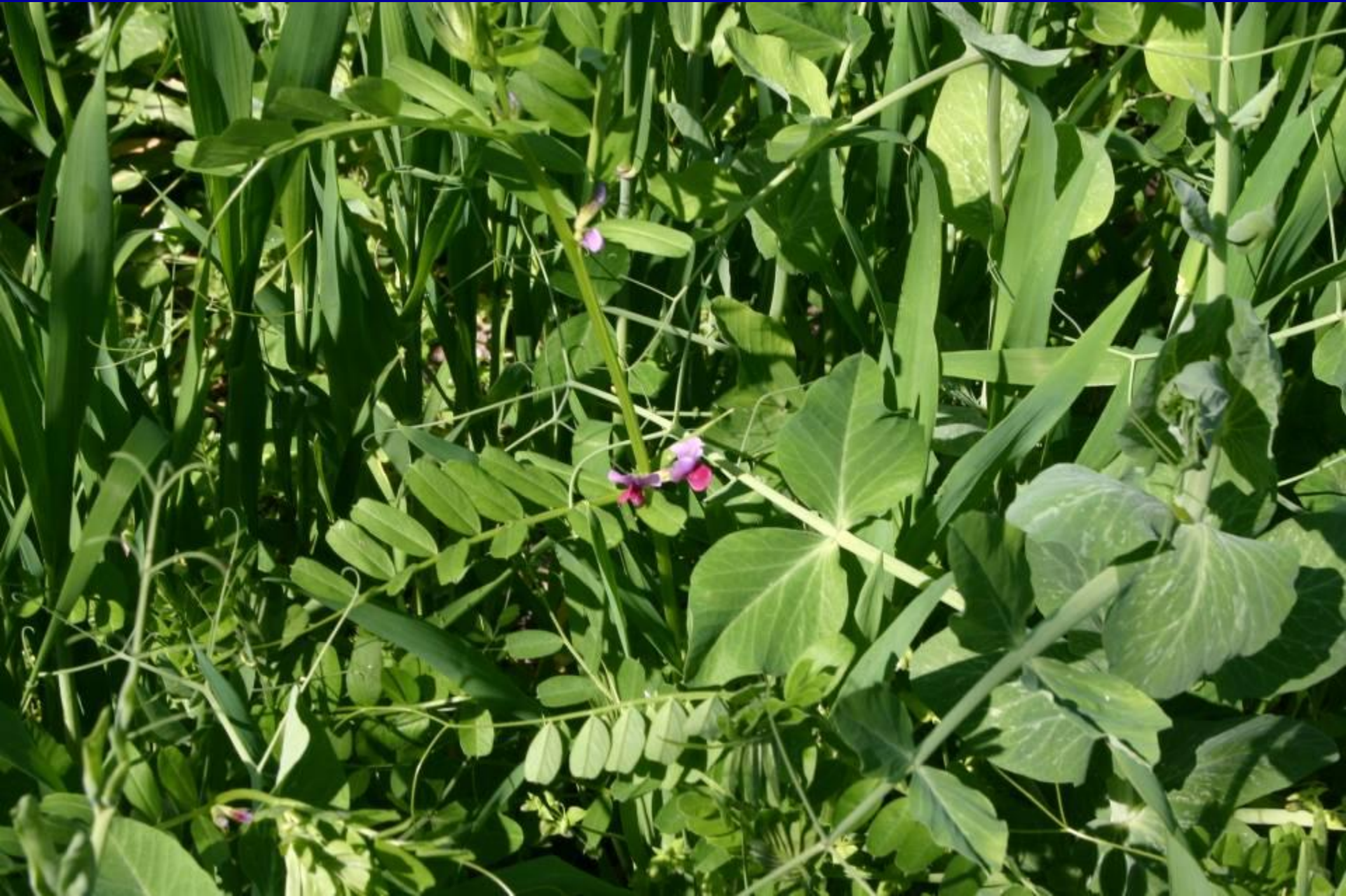


# Weeds can steal 2" water



**Figure 1. General relationship between soil moisture and texture.**  
**Ohio Agronomy Guide, 14th edition, Bulletin 472-05**

# Cover Crops add OM and Nutrients





**Till in cover  
crops as early  
as possible  
when the soil is  
workable**

**Provides  
organic matter,  
tilth, water  
retention, and  
nutrients**



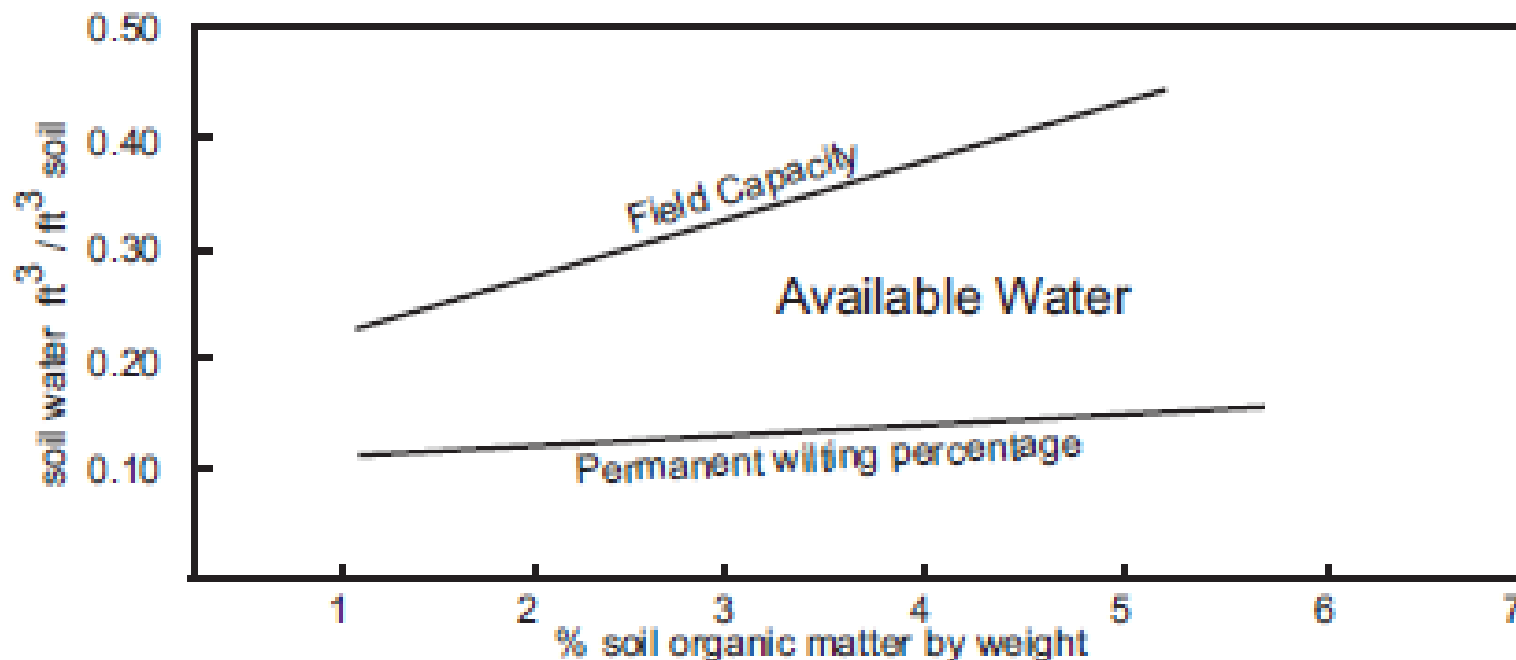
# Cultivation Increases Erosion Risk





# Soil Quality Indicators

**Increasing soil OM by 1% increases water holding capacity by about 0.03 ft<sup>3</sup>. (0.23 gallons) per ft<sup>3</sup>.**



*Figure 2. Effect of increasing organic matter on available water capacity of silt loam soils. Adapted from Hudson, SWCS, 1994.*

# **Loam soil holds about 1 gallon of water per cubic foot**

- **~ 10,000 gallons per acre = enough water to last about a 2 weeks**
- **Increasing OM by 1% would increase water holding capacity by about 25%**
- **Adding 10 tons of compost per acre (1% of top 8" of soil) every year for many years**
- **Need to add 20+ tons/acre to significantly raise OM – and limit cultivation**

**OM increases water holding capacity  
but not very much & its expensive**



**2 tons/acre compost**



# 10 vs. 20 tons/acre



- Cubic Yard ( $\text{yd}^3$ ) = about 850 lbs. = 0.43 tons so  $5 \text{ yd}^3 = 2 \text{ tons}$
- $10 \text{ tons/a} = 24 \text{ yd}^3$  at \$15 per  $\text{yd}^3$  = \$360 + delivery and spreading

# Making Your Own



# Sonoma Compost ?



# Irrigate Responsibly

- Stop leaks
- Reduce waste (drip)
- Don't over-irrigate
- Keep it uniform
- Time appropriately
- Right frequency



# Convert to Drip & save ~ 20%

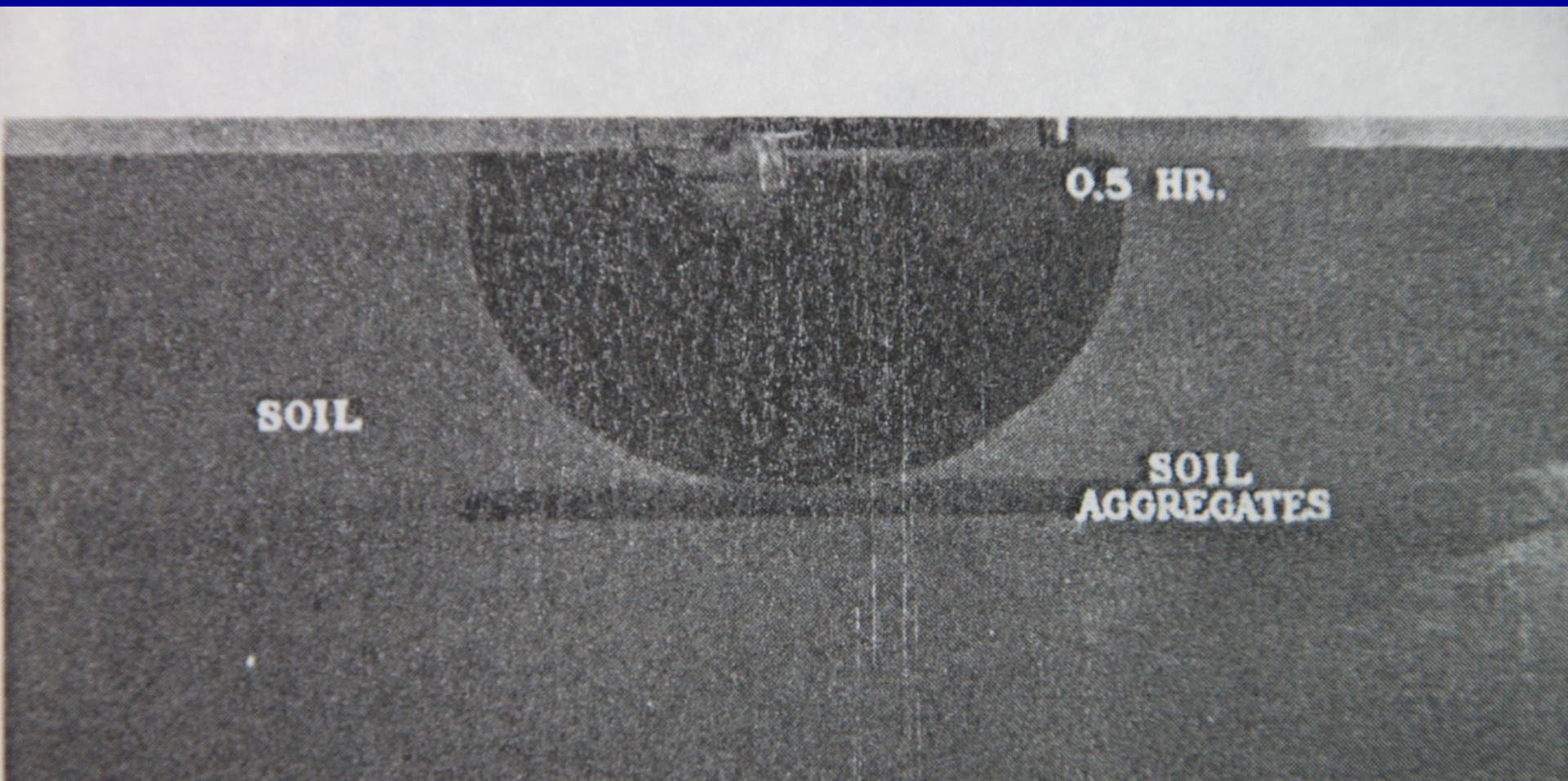


# Drip Irrigation

- Water plant daily – lightly – shallow
- Give the plant what it needs/wants
- Need is determined by  $ET_o$  + coefficient
- Exact an acceptable amount of stress
- Soil water holding capacity is not important



**For shallow rooted plants  
irrigate lightly every day**



# Plant - USE RATE

## How Much Water Plants Use

### Evapo - Transpiration (ET)

- Evaporation from soil surface = 10%
- Transpiration = 90% cooling of the leaves



# ETo Rates in the Press Democrat

Sonoma	71/53	0.00	40.74	20.71
St. Helena	77/59	0.00	23.71	19.48
Ukiah	75/56	0.00	39.05	28.23
Windsor	79/55	0.00	40.17	23.29
			34.14	21.03

\*Season runs July 1 through June 30

## RECORDS FOR TUESDAY SANTA ROSA

Average  
temperatures:  
High 77, Low 51

Record low:  
38 in 1933

Record high:  
95 in 1991

Average rainfall  
since July 1:  
30.83 inches

## FARM REPORT

Evapotranspiration:	Dewpoint:	
ETo Yesterday	0.17	8 a.m. Wednesday 53
ETo Last 7 days	1.05	2 p.m. Wednesday 60
ETo next 7 day	2.24	High/Low Thu. 62/53

Earthquake news: (510) 642-2160

River flow: (707) 944-5533 (Sonoma, Marin,  
Mendocino, Humboldt, Del Norte)

## VHF Radio

North Bay: 162.40 MHz  
South Bay: 162.55 MHz  
Sonoma Mt: 162.475 MHz

**PRESSDEMOCRAT.COM**  
FOR CONTINUOUS NEWS AND WEATHER



## LAKE

Lake So  
Capacity:  
245,042  
100.09%

Lake M  
Capacity:  
105,077.  
Elevation

Lake Pill  
Capacity:  
Water sup  
1,908 feet

Russian R  
At Haciend

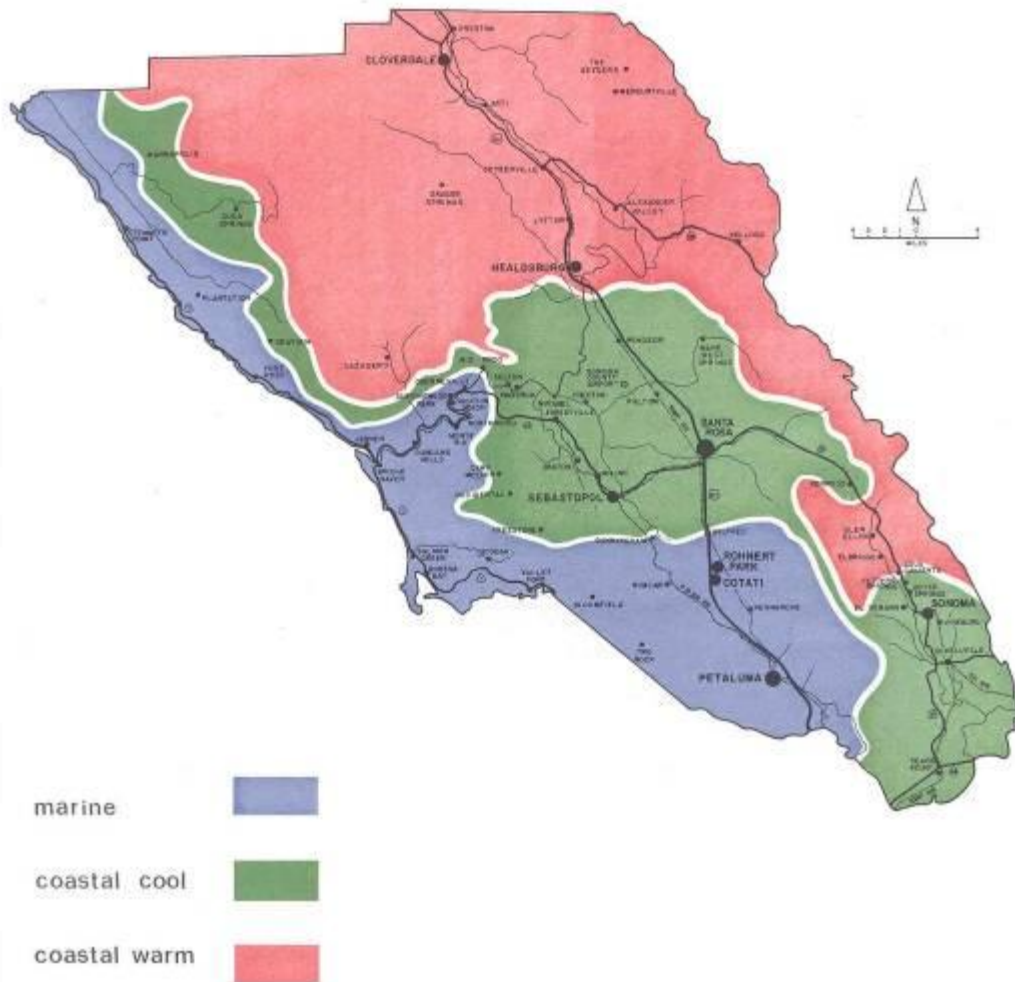
Clear Lak  
7.03 feet R  
1,318.26 fe

## INDEX Ultraviolet

0 5  
Low Mod

The higher the A  
UV Index™ num  
greater the need  
skin protection. S  
highest value of

## SONOMA COUNTY climatic zones



**Marine**

**Coastal Cool**

**Coastal Warm**

# Seasonal Water Requirement

April - October (30 yr. average in inches) (Sonoma County)

	<u>Marine</u>	<u>Coastal Cool</u>	<u>Coastal Warm</u>
April	2.8	4.0	4.5
May	2.9	5.8	6.9
June	2.8	5.6	7.0
July	3.4	6.1	7.9
August	3.1	5.2	6.8
Sept.	3.1	4.4	5.7
Oct.	<u>3.1</u>	<u>3.3</u>	<u>3.7</u>
TOTAL	21.2	34.4	42.5

# Typical water use patterns

## ETo - Inches per day

- Spring or fall with short cool days = 0.1
- Warm summer days with fog = 0.15
- Hot summer days with some fog = 0.20
- Hot summer days - no fog = 0.25
- Very hot days and windy = 0.30

# Climatic Zones

**Marine:** Foggy, windy, cool

- 2,185 degree days (1,800-2,800)
- Water use ~ 20-22"

**Coastal Cool:** Intermediate – some fog

- 2,582 degree days (1,900-3,600)
- Water use ~ 30-34"

**Coastal Warm:** Warm – little fog

- 2,920 degree days (2,100-4,200)
- Water use ~ 36-42"

# Max Potential Water Use (April-October)

	<u>ET (inches)</u>	<u>Gal/Acre</u>	<u>Gal/Min</u>	<u>Gal/1,000ft<sup>2</sup></u>
Marine	20	543,080	2.04	12,464
Coastal Cool	34	923,236	3.50	21,195
Coastal Warm	42	1,140,468	4.22	26,181

# Water Use in Gallons / Day

Plant Size	ET <sub>o</sub> →	0.1"/day	0.2"/day	0.25"/day	0.3"/day
	1 ft <sup>2</sup>	0.062	0.125	0.156	0.187
	10 ft <sup>2</sup>	0.62	1.25	1.56	1.87
	36 ft <sup>2</sup>	2.25	4.50	5.61	6.73
	100 ft <sup>2</sup>	6.20	12.5	15.6	18.7
	200 ft <sup>2</sup>	12.4	25.0	31.2	37.4
	300 ft <sup>2</sup>	18.6	37.5	46.8	56.1
	1 acre	2,715	5,431	6,788	8,146

*4 gpm X 60 min/hr X 24 hrs/day = 5,760 gallons per day*

# What NOT to Grow

- Plants that sunburn and die from water stress
- Plants where fruit size is important (fresh)
- Plants that have shallow root systems
- Late maturing varieties
- Plants that need heat and water

-----

Strawberry, raspberry, blueberry, blackberry,  
table olive, table grape, peach, nectarine, pear,  
asparagus, pepper, eggplant, squash, cutting  
greens, spinach, watermelon, corn, beans,  
summer onion

# What to Grow

- Plants that have been successfully dry farmed
- Plants that are deep rooted
- Plants where fruit size does not matter (processed)
- Plants that naturally tolerate water stress
- Plants that mature in winter & spring
- Short season varieties (early maturing)

-----

- Oil olives, wine grapes, processing apples, some pears, plums, prunes, apricots, potatoes, tomatoes, cole crops, radishes, peas, winter greens, winter alliums, bunch lettuce, melon - -

# Organic Mulch



# Mulch in furrows



# Plastic Mulch



# Hand Buried Plastic



# Plastic Mulch



# Good Weed Control = No Competition



# Weeds



# Lots of hand weeding



# Transplant to get ahead of weeds



# Transplanted Onions



# Transplanting requires more labor



# Precision Weeding Equipment



# Precision Transplanter





## Mechanized Precision Beds



# Precision Seeders



# Precision Bed Cultivation



# Thanks! – Questions?

