University of California

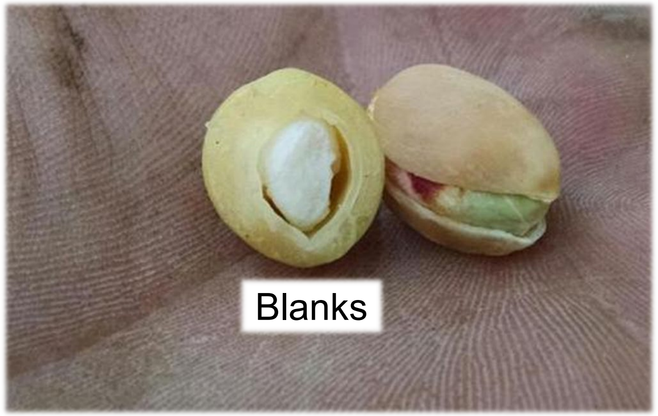
Pistachio Day

Water Management Strategies During Drought

Mae Culumber

Nut Crop Advisor, Fresno County

Drought impacts tree vigor, fruit quality and yield



https://www.bakersfield.com/news/business/high-rate-of-pistachio-blanks-worries-local-nut-growers/article_e711c5cb-8532-565e-bc9f-1f3b6807cdaa.html

Water management decisions during drought

Q. Blanket reduction in water application throughout the season or targeted deficit during different growth stages?

A. Targeted deficit best approach based on research

Goldhamer and Beede *Journal of Horticultural Science & Biotechnology* 2004, UC Pistachio production manual 2016 p. 134-135*:*

"The most stress-sensitive period begins with the onset of rapid kernel growth (Stage 3). Water deprivation during Stage 3 reduced individual nut size, shell splitting, harvestability and increased nut blanking and kernel abortion".

"Deficit irrigating at 50% ETc during Stage 2 and reducing post harvest irrigation by about 70% significantly increased irrigation water use efficiency relative to near full irrigation".

- Other practices that conserve water in both normal and drought years?

How to manage irrigation during drought?

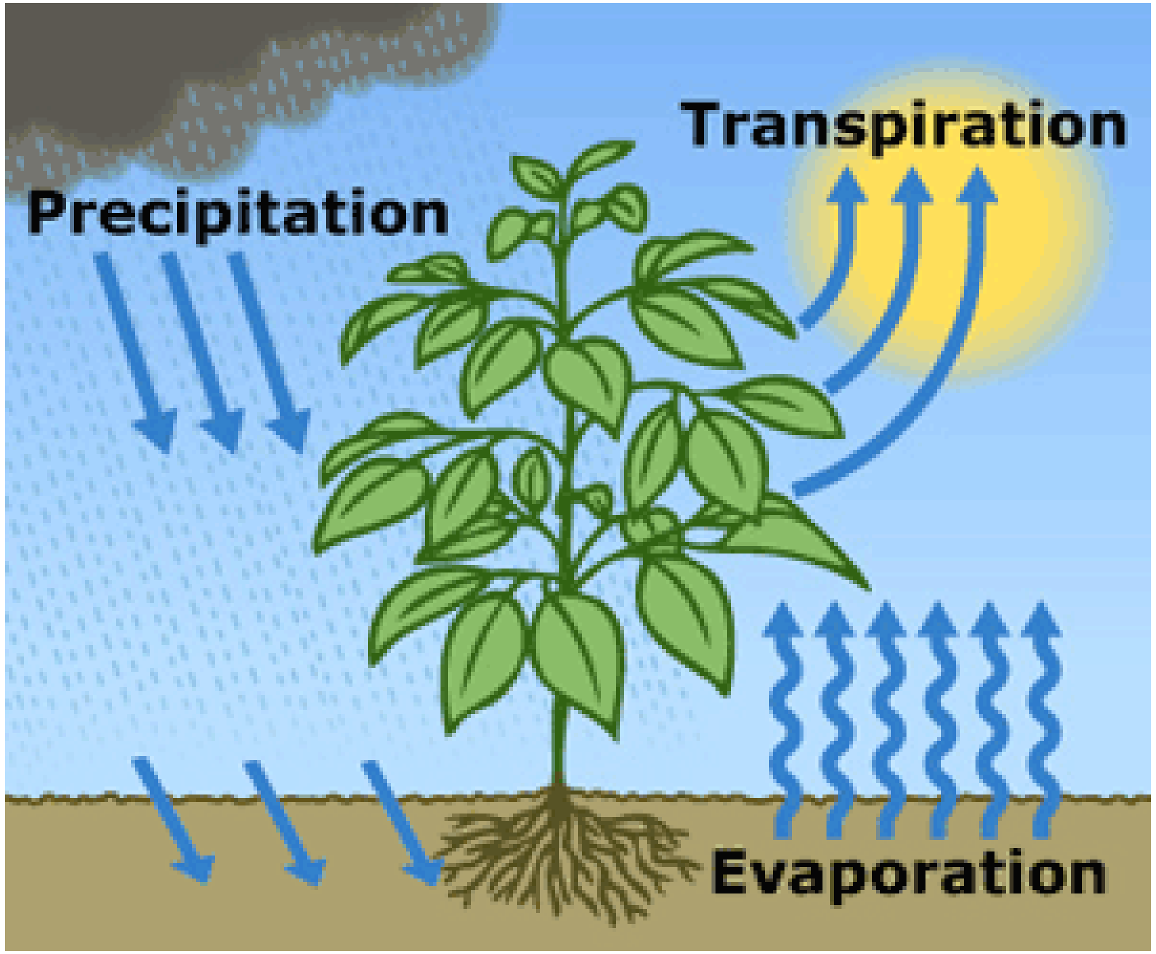
Estimate of crop evapotranspiration (ET) since last irrigation or rainfall

Root zone soil water storage

Irrigation system application rate, evaluation, and maintenance

Pistachio thresholds for moisture stress

Saline locations



Evapotranspiration (ET)

The sum of evaporation and plant transpiration and the movement of water from land surfaces and plant canopies to the atmosphere.

Evapotranspiration Terms:

- **ET_a** actual evapotranspiration of crop (pistachio) through the growing season determined by on-site micrometeorological methods (eddy covariance, surface renewal)

CIMIS
CALIFORNIA IRRIGATION MANAGEMENT INFORMATION SYSTEM
CALIFORNIA DEPARTMENT OF WATER RESOURCES

https://cimis.water.ca.gov/Stations.aspx

- **ET_o** = evapotranspiration of reference crop (grass)
    - based on historical average or real time
- **Forecast ET_o** = reference grass prediction for 1-7 days based on weather outlook
- **K_c** = ratio of water need of pistachio (ET_a) / water need of grass (ET_o)
- **ET_c** = calculated evapotranspiration of crop (pistachio) **acre-inches**

$$ET_c = ET_o \times K_c$$

Research shows actual water use is highly variable

ET_a	Averaged Water Requirements (inches)					
Bi-weekly period	S0 - Nichols (2016-2019)	S0 - Gebhardt (2018-2019)	S1 - Flores (2016-2019)	S2 - Flores (2016-2019)	S3 - Flores (2016-2019)	UC ANR (2005)
Apr 1-15	1.16	1.56	1.41	0.82	1.30	0.21
Apr 16-30	2.27	3.34	2.33	1.93	2.02	1.67
May 1-15	3.11	3.93	3.16	2.58	2.47	2.82
May 16-31	3.08	3.33	3.82	2.90	2.92	3.39
Jun 1-15	4.64	4.95	4.19	3.49	3.03	6.17
Jun 16-30	4.87	5.70	4.73	3.95	3.28	6.75
Jul 1-15	4.85	5.72	4.45	3.76	3.19	7.04
Jul 16-31	4.82	5.92	4.65	3.99	3.41	7.40
Aug 1-15	4.23	4.89	3.74	3.40	2.83	6.49
Aug 16-31	4.12	4.45	3.51	3.06	2.65	5.87
Sept 1-15	3.33	3.98	2.40	1.66	1.84	4.61
Sept 16-30	2.66	2.88	1.76	1.47	1.36	3.33
Oct 1-15	1.75	2.22	1.03	0.80	0.99	2.12
Oct 16-31	1.68	1.63	0.84	0.74	1.02	1.52
Nov 1-15	0.79	0.93	0.38	0.51	0.60	0.79
Total	**47.36**	**55.42**	**42.72**	**35.07**	**33.40**	**60.56**

	Averaged Crop Coefficient (Kc) values					
Bi-weekly period	S0 - Nichols (2016-2019)	S0 - Gebhardt (2018-2019)	S1 - Flores (2016-2019)	S2 - Flores (2016-2019)	S3 - Flores (2016-2019)	UC ANR (2005)
Apr 1-15	0.37	0.52	0.44	0.26	0.44	0.07
Apr 16-30	0.59	0.86	0.65	0.52	0.52	0.43
May 1-15	0.79	0.94	0.86	0.71	0.66	0.68
May 16-31	0.82	0.91	0.89	0.66	0.70	0.93
Jun 1-15	0.89	0.94	0.80	0.67	0.58	1.09
Jun 16-30	0.89	1.05	0.86	0.72	0.60	1.17
Jul 1-15	0.90	1.04	0.83	0.70	0.60	1.19
Jul 16-31	0.84	1.03	0.81	0.70	0.60	1.19
Aug 1-15	0.86	0.97	0.77	0.69	0.58	1.19
Aug 16-31	0.86	0.96	0.73	0.64	0.55	1.12
Sept 1-15	0.82	0.92	0.59	0.52	0.45	0.99
Sept 16-30	0.78	0.81	0.50	0.41	0.38	0.87
Oct 1-15	0.62	0.78	0.35	0.27	0.30	0.67
Oct 16-31	0.59	0.58	0.32	0.33	0.39	0.50
Nov 1-15	0.41	0.41	0.23	0.28	0.35	0.35

- Influenced by tree age, vigor, crop load, climate, soil texture, and salinity levels

Bi-Weekly Pistachio Water Budget Example

Timeline	Crop Coef. (Kc) UCANR 2005	ETo	ETc	Accum. ETc	Rain	Rain accum	Acumm deficit	Hours irrigation @ 0.13 in/hr/wk 95% effic.
Apr 1-15	0.07	2.71	0.19	0.17	1.0	1.00	none	none
Apr 16-30	0.43	3.49	1.50	1.69	1.7	2.7	none	none
May 1-15	0.68	3.73	2.53	4.23	0.5	3.2	1.03	none
May 16-31	0.93	3.28	3.05	7.28	0.25	3.5	3.78	31
Jun 1-15	1.09	5.09	5.55	12.83	0			45
Jun 16-30	1.17	5.19	6.08	18.91	0			49
Jul 1-15	1.19	5.32	6.33	25.24	0			51
Jul 16-31	1.19	5.60	6.66	31.90	0			54
Aug 1-15	1.19	4.91	5.84	37.74	0			47
Aug 16-31	1.12	4.71	5.28	43.02	0			43
Sep 1-15	0.99	4.19	4.15	47.18	0			34
Sep 16-30	0.87	3.44	2.99	50.17	0			24
Oct 1-15	0.67	2.84	1.90	52.07	0			15
Oct 16-31	0.50	2.74	1.37	53.44	0			11
Nov 1-15	0.35	2.04	0.71	54.16	0			2

~50” applied water

Online Resources for Water Budgeting

- Weekly ETc reports – DWR & UCCE
- (FRET) National Weather Service – Forecast ETo
- CropManage – UC ANR

[Weekly ETc reports](#)

DWR & UCCE

- Previous week's ETc (acre-inches) based on CIMIS station data and next week's prediction based on the 30-year average for a variety of crops

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UCCE

UCCE/DWR Weekly Crop Water Use Report

WEEKLY SOIL MOISTURE LOSS IN INCHES
(Estimated Crop Evapotranspiration or ET_C)
07/16/21 through 07/22/21

Crops (Leafout Date)	#148 Merced			#39 Parlier			#258 Lemon Cove		
	7/16- 7/22 Water Use	Accum'd Seasonal Water Use	7/23- 7/29 Estimated ETc	7/16- 7/22 Water Use	Accum'd Seasonal Water Use	7/23- 7/29 Estimated ETc	7/16- 7/22 Water Use	Accum'd Seasonal Water Use	7/23- 7/29 Estimated ETc
Almonds (3/5) *	1.98	28.07	2.03	2.05	29.64	1.92	1.91	27.96	1.94
Pistachio (4/16) * **	2.05	22.32	2.10	2.12	23.76	1.99	1.98	22.24	2.01
Citrus (2/1)	1.20	23.35	1.26	1.25	24.49	1.15	1.17	23.12	1.17
Raisin Grapes (3/12) (11 ft. row spacing)	1.56	18.03	1.61	1.61	19.26	1.50	1.50	18.02	1.52
Winegrapes (3/12) (10 ft. spacing on California Sprawl Trellis) ***	1.77	19.46	1.82	1.85	20.74	1.71	1.71	19.41	1.73
Walnuts (4/5)	2.12	24.34	2.17	2.19	25.82	2.06	2.04	24.24	2.08
Stone Fruit (3/10)	1.91	20.89	2.08	2.00	22.23	1.97	1.85	20.85	1.99
Past 7 days precipitation (inches)		0.00			0.00			0.00	
Accumulated precipitation (inches) (1/1/2021)		5.54			3.66			3.90	

Dates in parentheses above, indicate leaf out or starting date for ET accumulation for the specific crop
* Estimates are for orchard floor conditions where vegetation is managed by some combination of strip applications of herbicides, frequent mowing or tillage, and by mid and late season shading and water stress. Weekly estimates of soil moisture loss can be as much as 25 percent higher in orchards where cover crops are planted and managed more intensively for maximum growth.
** Very vigorous, non-salt affected peak season pistachio Kc can be as high as 1.19 – resulting in about 8% greater water use than shown in these tables.

PAST WEEKLY APPLIED WATER IN INCHES, ADJUSTED FOR EFFICIENCY [1]

Crops	#148 Merced				#39 Parlier				#258 Lemon Cove			
System Efficiency >>	65%	75%	85%	95%	65%	75%	85%	95%	65%	75%	85%	95%
Almonds (3/5)	3.0	2.6	2.3	2.1	3.2	2.7	2.4	2.2	2.9	2.5	2.2	2.0
Pistachio (4/16)	3.2	2.7	2.4	2.2	3.3	2.8	2.5	2.2	3.0	2.6	2.3	2.1
Citrus (2/1)	1.8	1.6	1.4	1.3	1.9	1.7	1.5	1.3	1.8	1.6	1.4	1.2
Raisin Grapes (3/12) (11 ft. row spacing)***	2.4	2.1	1.8	1.6	2.5	2.1	1.9	1.7	2.3	2.0	1.8	1.6
Winegrapes (3/12) (10 ft. spacing on California Sprawl Trellis) ***	2.7	2.4	2.1	1.9	2.8	2.5	2.2	1.9	2.6	2.3	2.0	1.8
Walnuts (4/5)	3.3	2.8	2.5	2.2	3.4	2.9	2.6	2.3	3.1	2.7	2.4	2.1
Stone Fruit (3/10)	2.9	2.5	2.2	2.0	3.1	2.7	2.4	2.1	2.8	2.5	2.2	1.9

1 The amount of water required by a specific irrigation system to satisfy evapotranspiration. Typical ranges in irrigation system efficiency are: Drip, 80%-95%; Micro-sprinkler, 80%-90%; Sprinkler, 70%-85%; and Border-furrow, 50%-75%.

PAST WEEKLY APPLIED WATER IN GALLON PER TREE OR VINE

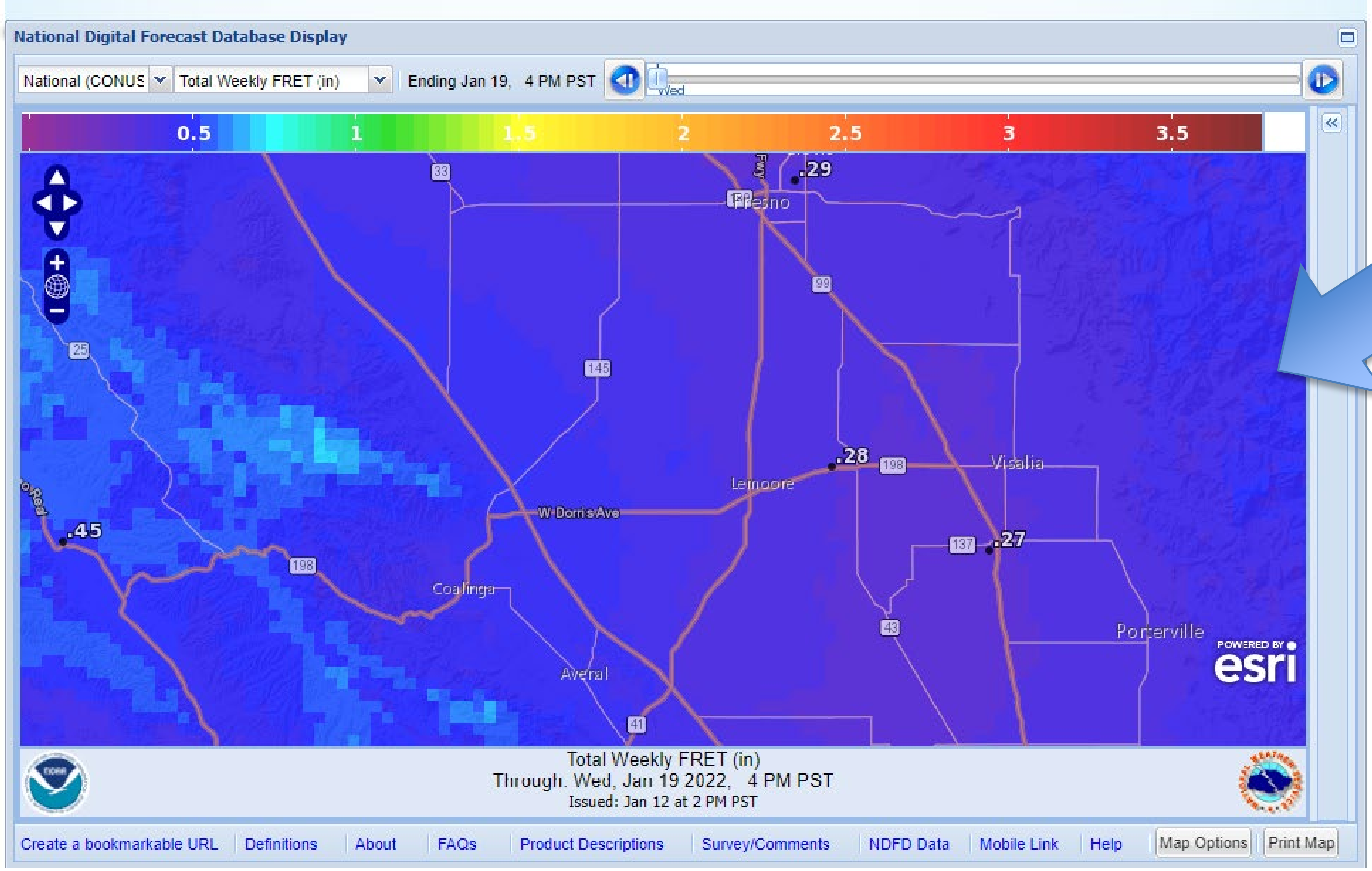
Crops	#148 Merced				#39 Parlier				#258 Lemon Cove			
Almonds 115 Trees/A	708	614	543	496	756	638	567	519	685	590	519	472
Pistachio 106 Trees/A	797	673	598	548	822	698	623	548	747	648	573	523
Citrus 110 Trees/A	444	395	346	321	469	420	370	321	444	395	346	296
Raisin Grapes 566 Vines/A	115	101	86	77	120	101	91	82	110	96	86	77
Winegrapes 622 Vines/A	118	105	92	83	122	109	96	83	114	100	87	79
Walnuts 76 Trees/A	1179	1000	893	786	1215	1036	929	822	1108	965	857	750
Stonefruit 172 Trees/A	458	395	347	316	489	426	379	332	442	395	347	300

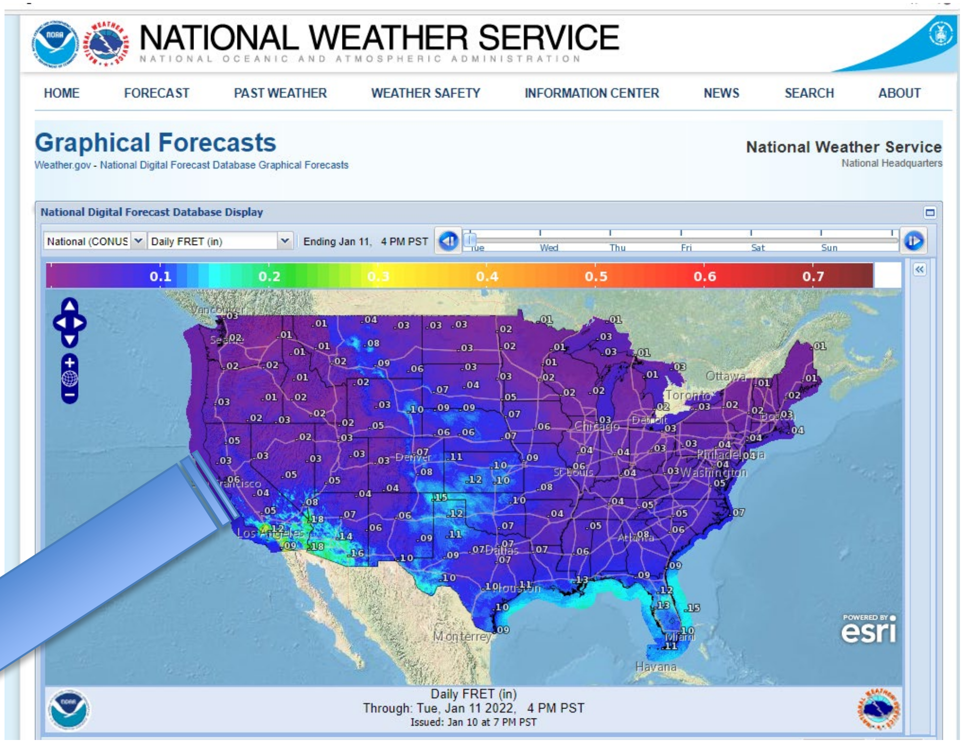
For further information concerning all counties receiving this report, contact the Fresno Co. Farm Advisor's office at (559) 241-7526.

- Contact your local farm advisor to get on weekly ET report list

[(FRET) National Weather Service](#) – Forecast ETo

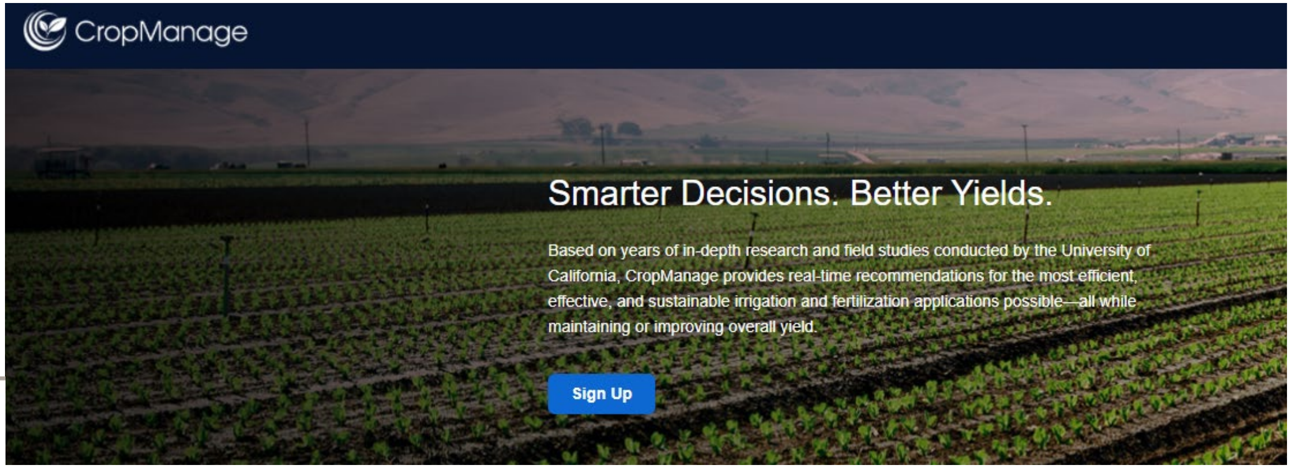
- Provides predicted ETo to plan irrigation schedules for seven days in the future



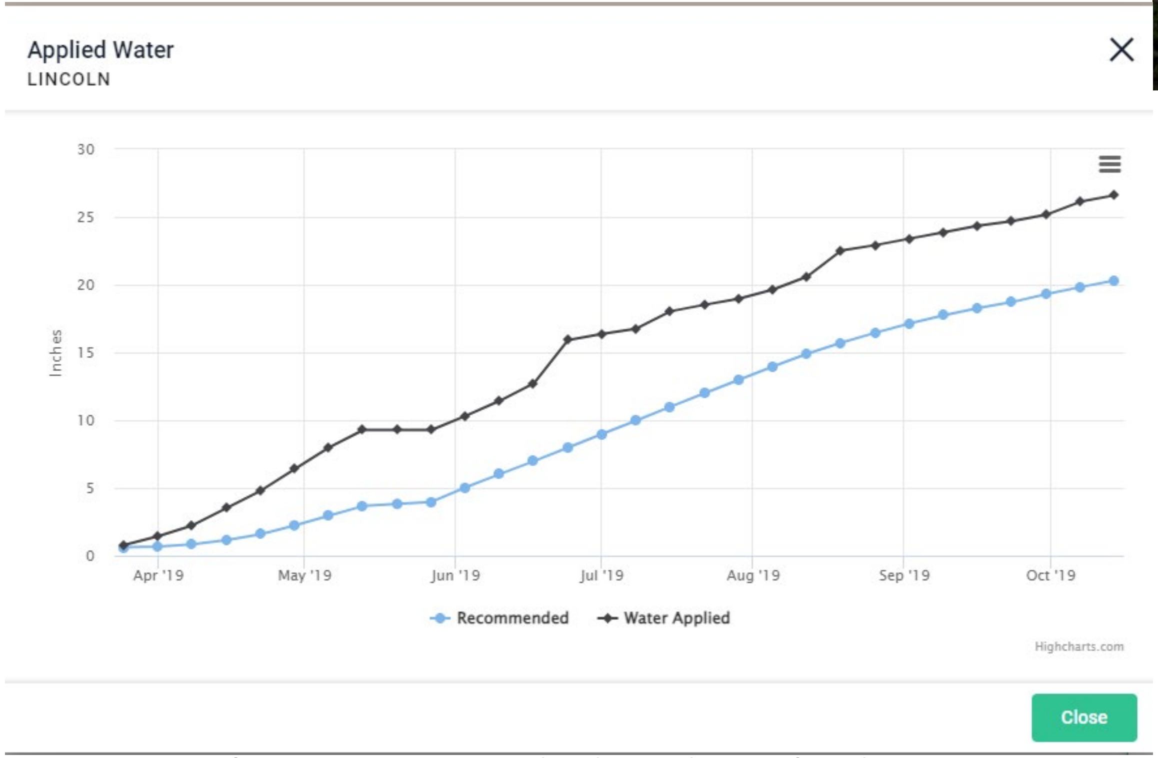


- User needs to apply Kc to determine ETc and depth of water for irrigation scheduling
- Example later in the presentation

CropManage – UC ANR



https://cropmanage.ucanr.edu/login



Tracks recommended and applied water

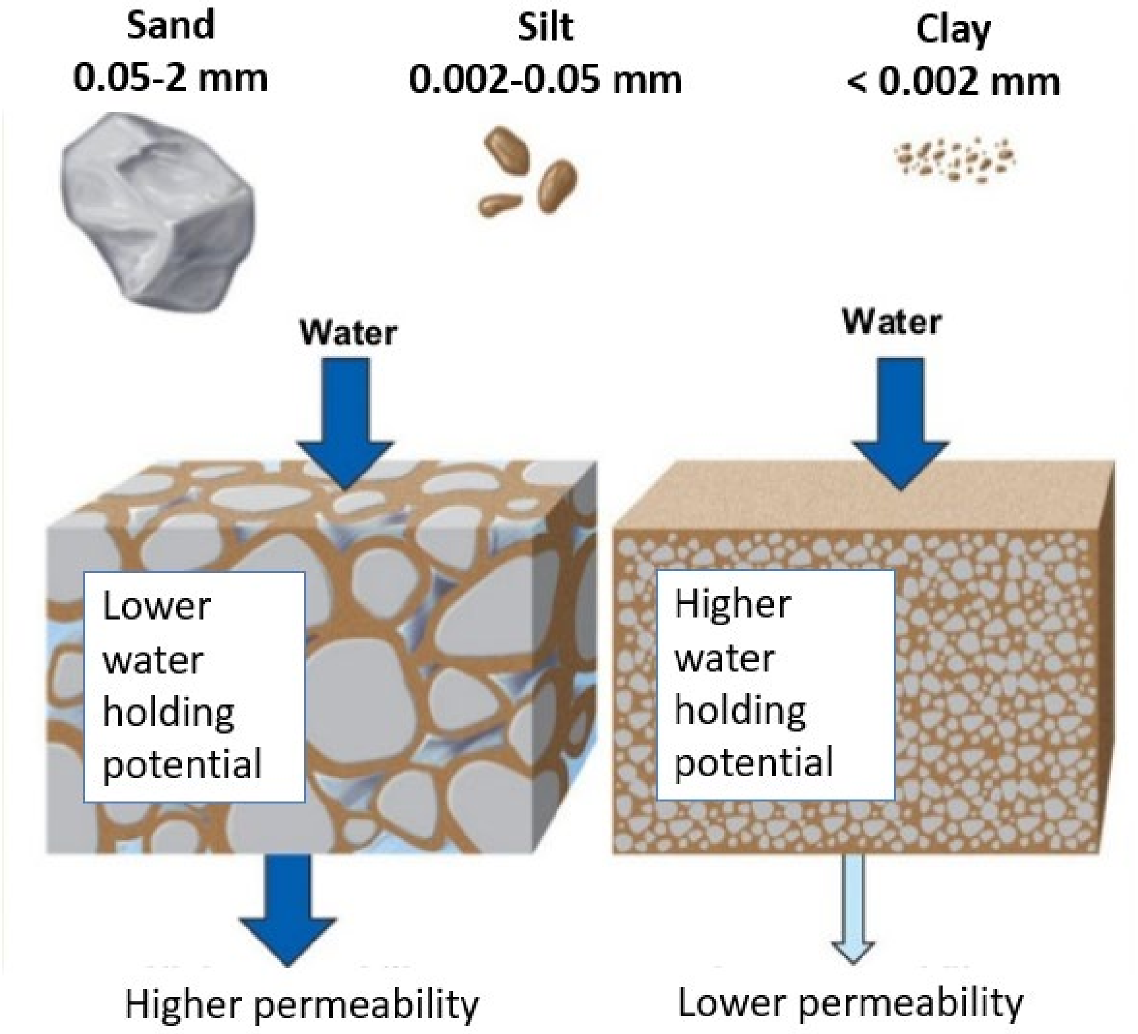
- Uses evapotranspiration (ET) data from CIMIS adjusted with crop coefficient or can input on-site weather station information to make a weekly recommendation
- Can be used by managers to track fertilizer inputs, soil, and tissue sampling, and yield information to calculate future management recommendations

How to manage irrigation during drought?

- Estimate of crop evapotranspiration (ET) since last irrigation or rainfall
- **Root zone soil water storage**
- Irrigation system application rate, evaluation, and maintenance
- Pistachio thresholds for moisture stress
- Saline locations

Soil texture and water holding capacity

- Sand has largest particle size but lower surface area than silt and clay
- Small particles have more surface area relative to volume
- More surface area = more water retention
- Coarse textured soil have greater permeability



Soil texture and water availability

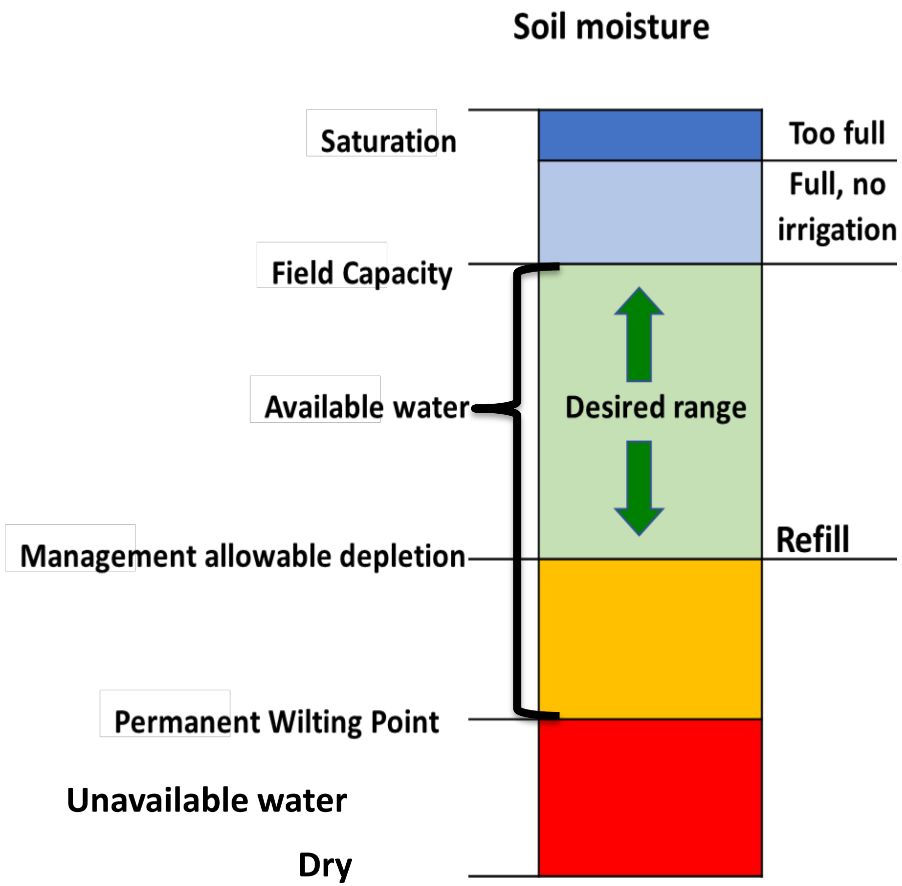
Table 1. Average available water-holding capacity (W_a) for various soil textures

Soil		W_a (inches of water per foot of soil)
General description	Texture class	
light, sandy	coarse sand	0.5
	fine sand	0.9
	sandy loam	1.2
medium, loamy	fine, sandy loam	1.5
	loam	1.8
	silt loam	2.0
heavy, clay	clay loam	2.2
	clay	2.4
	peat/muck	6.0

Source: Modified from U.S. Bureau of Reclamation, Agrimet Irrigation Guide website, (https://www.usbr.gov/pn/agrimet/irrigation.html).

Water Budgeting with Soil Moisture

- Apply water at the right rate and frequency to maintain soil available water in the desired range to avoid severe stress
- **Available water:** Range between field capacity and permanent wilting point
- **Management allowable depletion (MAD)** amount of available water remaining before crop limiting stress
- Pistachios MAD ~40- 60% of the total available water, varies by crop development stage and soil type



Moisture sensors track depletion and depth of moisture after irrigation

Use the following readings as a general guideline:

0-10 Centibars = Saturated soil

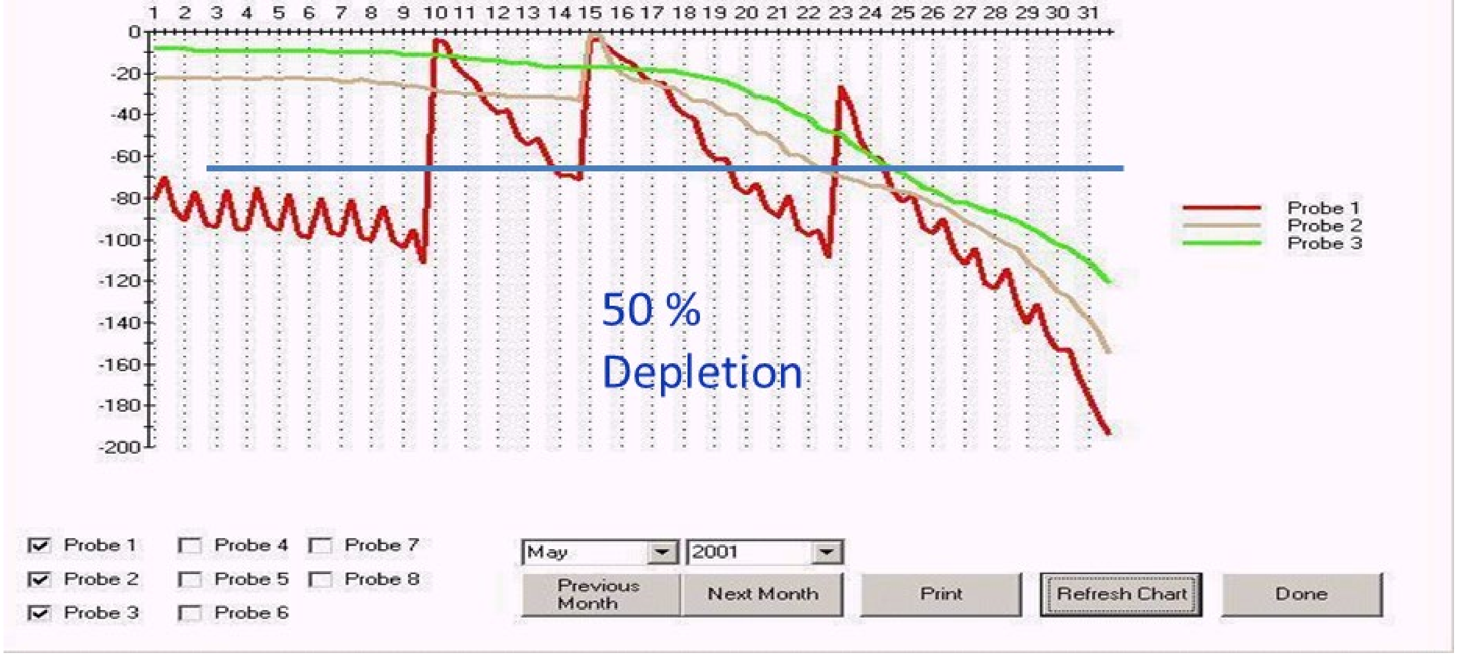
10-30 Centibars = Soil is adequately wet (except coarse sands, which are beginning to lose water)

<u>**30-60 Centibars** = Usual range for irrigation (most soils)</u>

60-100 Centibars = Usual range for irrigation in heavy clay

100-200 Centibars = Soil is becoming dangerously dry for maximum production. Proceed with caution!

http://www.irrometer.com



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Irrigation System Water Application Rate

- ET_c is reported in acre-inches
- Irrigation system flow rate presented as gallons per minute (gpm), cubic feet per second (cfs), or acre-feet

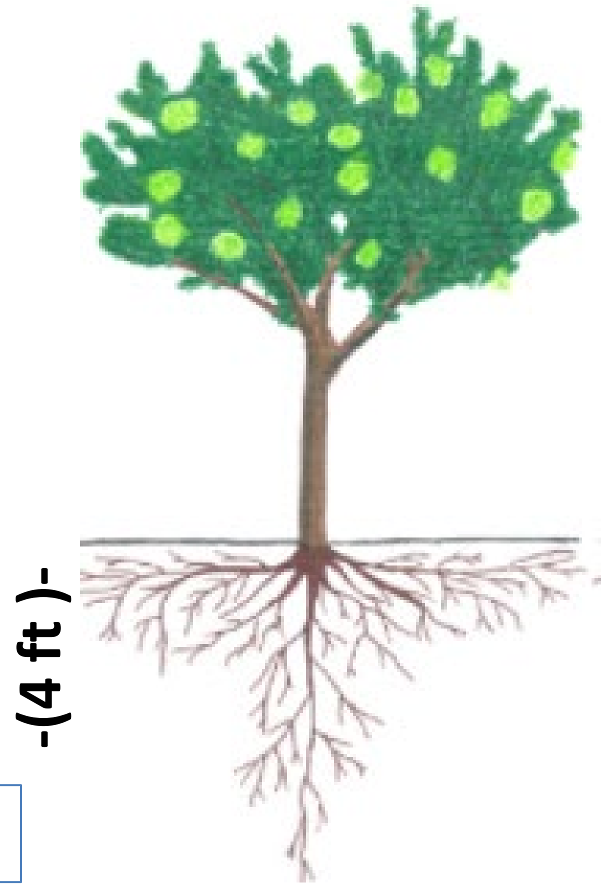
To **convert gallons to acre-inches** you need to know:

- Emitter discharge rates gallons per hour (gph)
- Number of emitters per tree
- Trees per acre
- 27,154 gallons/acre inch

Irrigation system ac-in/hr =
(gal/hr/emitter) X (# emitters per tree) X (# trees per acre) ÷ 27,154 gallons/ac-in
or
water use gal/week = crop water use (in/week) x 27,154 gallons/acre inch ÷ # plantings per acre

Maximum water depth applied per irrigation

- soil texture and available water holding capacity (W_a)
- average (Z) or **effective rooting (Z_E) depth**
- management allowable depletion (MAD) for the crop
- Irrigation system efficiency (Eff_A)
  - Surface drip 85-95%



Maximum water depth to apply = $[(MAD \div 100) \times W_a \times Z_E] \div Eff_A$

Rootzone soil water availability

Table 1. Average available water-holding capacity (W_a) for various soil textures

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	loam	1.8
	silt loam	2.0
heavy, clay	clay loam	2.2
	clay	2.4
	peat/muck	6.0

Source: Modified from U.S. Bureau of Reclamation, Agrimet Irrigation Guide website, (https://www.usbr.gov/pn/agrimet/irrigation.html).

Water applied = [(MAD ÷ 100) x W_a X Z_E] ÷ Eff_A

Management Allowable Depletion (MAD)

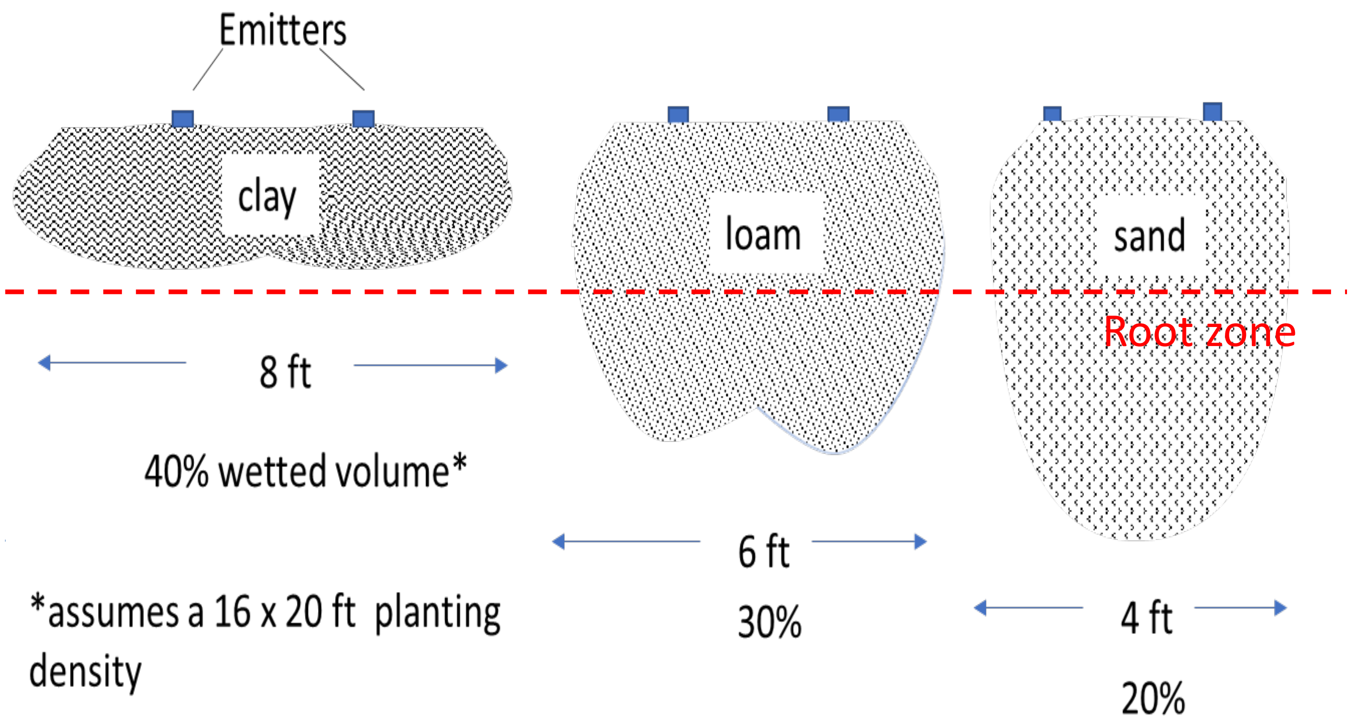
Table 2. **Average root depth (Z) and management allowable depletion (MAD) for different crops**

Crop	Average root depth (ft)	MAD (%)
alfalfa	8.0	55
pasture	2.5	50
turf	1.5	50
small grains	4.5	55
beans	3.0	40
corn	5.5	50
potatoes	3.5	40
sugar beets	4.0	50
cotton	5.0	55
orchards	8.0 $Z_E = 4.0$	50–65
grapes	6.0	65

Source: Modified from U.S. Bureau of Reclamation, Agrimet Irrigation Guide website, (https://www.usbr.gov/pn/agrimet/irrigation.html).

Water applied = $[(\mathbf{MAD} \div 100) \times W_a \times \mathbf{Z_E}] \div Eff_A$

Consider Irrigation System % wetted area



Easy to over-irrigate (lose water to deep percolation or exceed infiltration rate)

Need to consider the % of wetted area influence by the system and soil type

0.04 in/hr ÷ 30% wetted area on loam soil = 0.13 in/hr

Maximum water depth applied per irrigation

Water applied = [(MAD ÷ 100) x W_a X Z_E] ÷ Eff_A

MAD = 60%
W_a sandy-loam = 1.2 inches
Z_E = effective rooting depth 4 ft
Eff_A = 95%
Water applied = [(60 ÷ 100) x 1.2 inches X 4 ft] ÷ 0.95

Max. Water applied per irrigation = No more than 3.0 inches water applied per set

Calculate the maximum irrigation time:

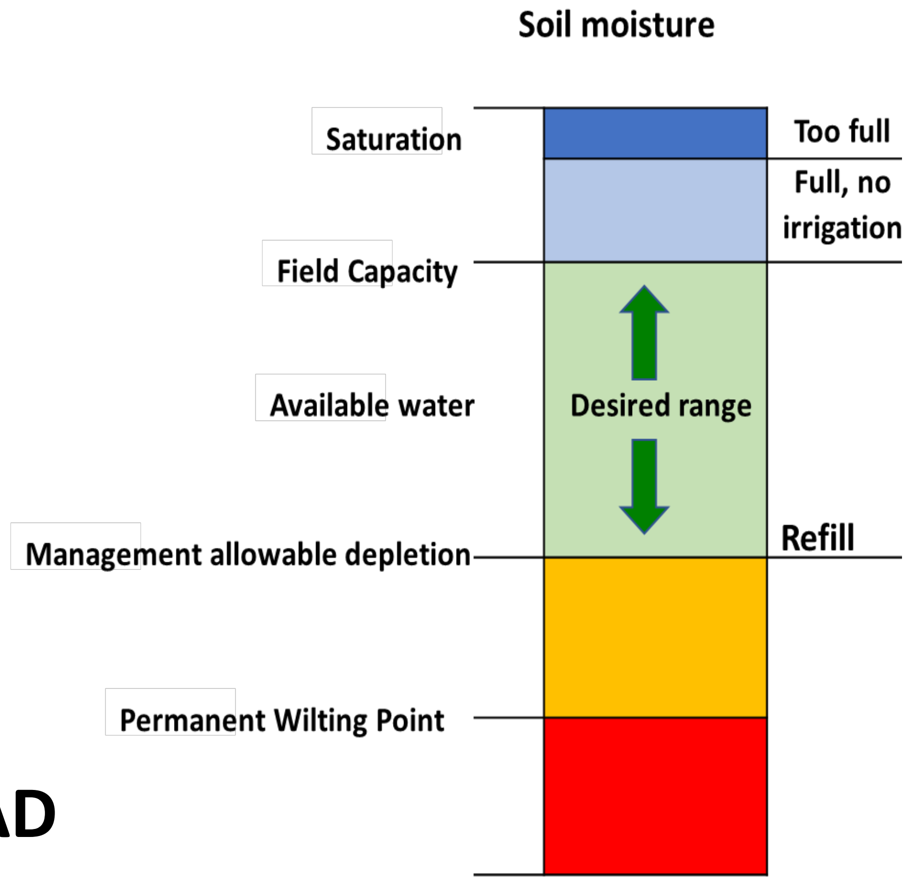
Example: if application rate is 0.13 in/hr (rate considers the % wetted area)

3 in ÷ 0.13 in/hr = maximum irrigation time 23 hrs

Note* If weekly ETc exceeds maximum irrigation time, shorter more frequent sets may be necessary

Management allowable depletion and irrigation set intervals

- MAD = 60%
- W_a sandy-loam = 1.2 inches/ft
- Z_E = effective rooting depth 4 ft
- Soil moisture at field capacity = 4.8 in
- Soil moisture at MAD = 1.9 in
- 4.8 – 1.9 in = 2.9 inches loss
- If daily ET in July = 0.75 inches
- 2.9 in ÷ 0.75 in/day = ~**3-4 days to 60% MAD**



Drought impacts water supply

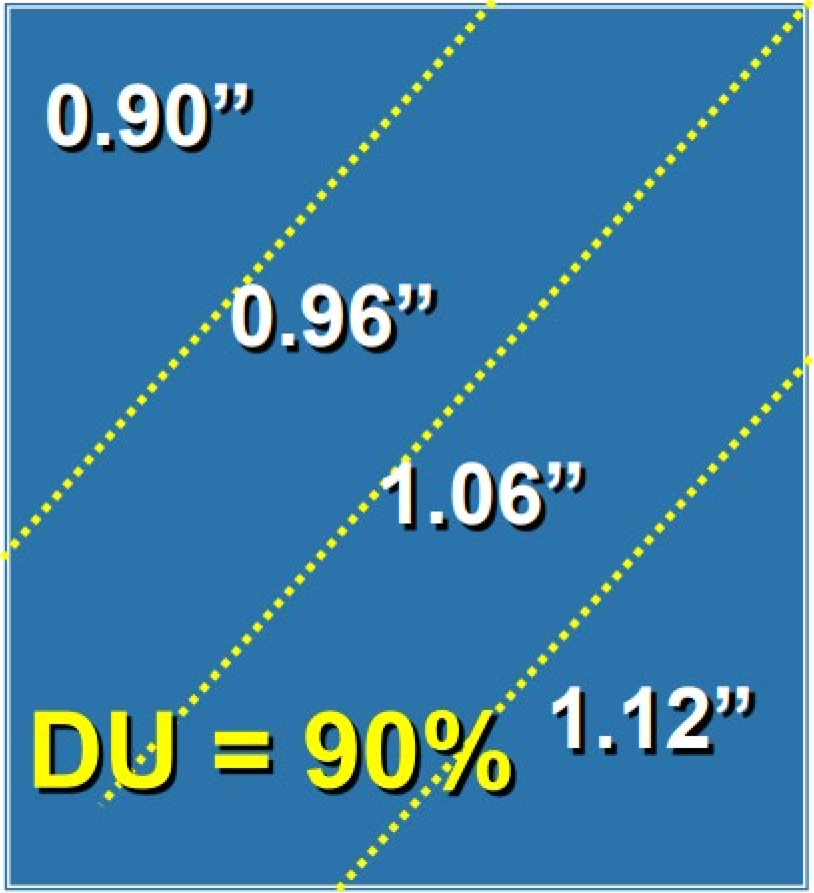
- Drought decreases surface water availability and increases demand on groundwater
- Decreased flow rates raises water temperature, pH, elevates salt concentrations and other chemical and biological characteristics of the water
- May impact application rate and distribution uniformity

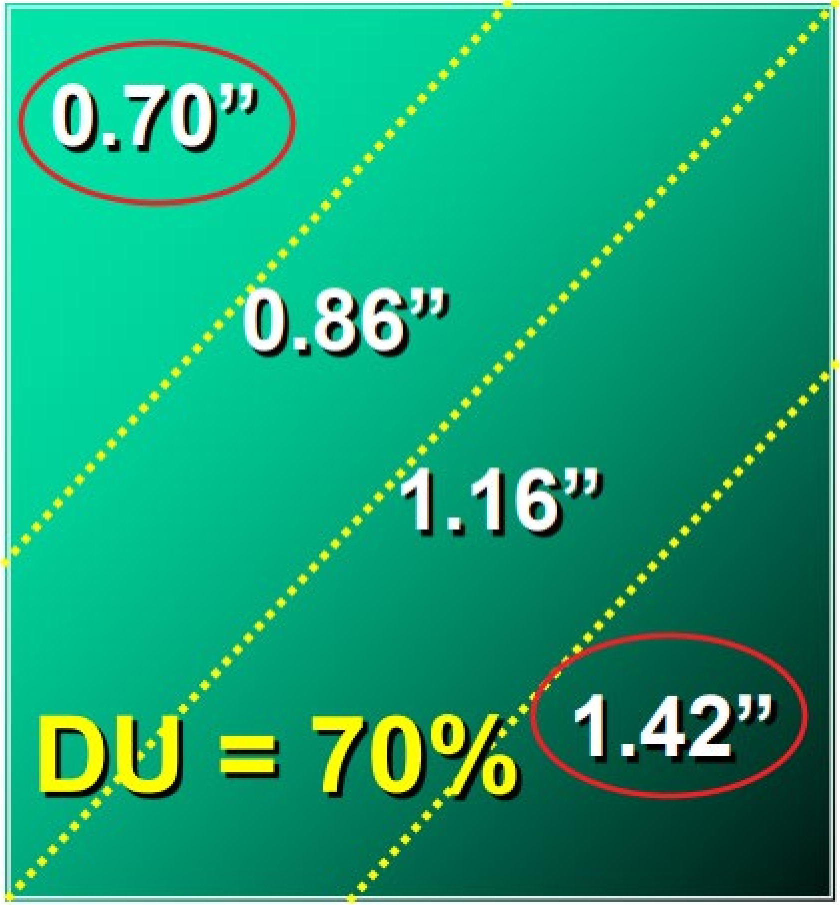
Irrigation System Evaluation and Maintenance

- Small micro-emitters openings highly susceptible to clogging and leaks
- Routine inspection and maintenance is essential
  - Examine nozzles and wetting patterns
  - Flush lines and clean filters
  - Install and check flow meters and inlet pressure sensors

Irrigation System Evaluation and Maintenance

Photo: D. Zaccaria





Slide: A. Fulton

- Micro irrigation systems are highly efficient but almost all will have varying level of distribution uniformity (DU) across the block
- Professional system evaluation recommended every 2-3 years, and in drought years

DU	Water Applied High ¼ of orchard	Water Applied Low ¼ of orchard	Difference across orchard one irrigation	Difference thirty irrigation cycles
	------------------ Inches applied -------------------			
90	1.12	0.90	0.22	6.6
80	1.27	0.80	0.47	14.1
70	1.42	0.70	0.72	21.6

Slide: A. Fulton

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- **Pistachio thresholds for moisture stress**
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ANR Publication 8503 | May 2014
http://anrcatalog.ucanr.edu
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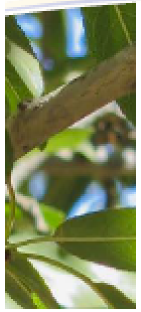
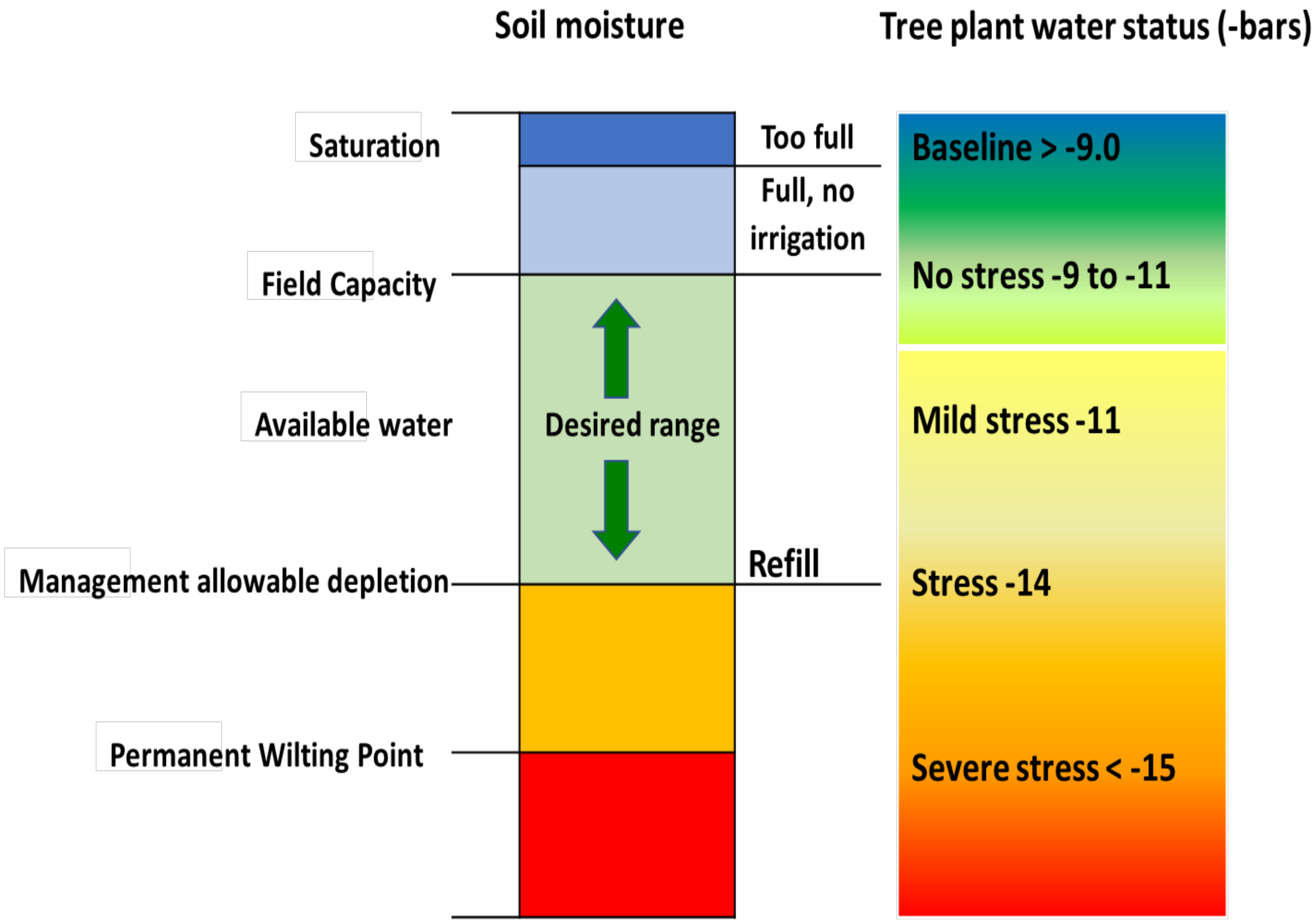


Using the Pressure Chamber for Irrigation Management in Walnut, Almond, and Prune

- Irrigating according to a water budget and soil moisture doesn’t indicate how orchard trees respond to the applied water schedule
- Midday SWP <u>integrates</u> and quantifies how an orchard is responding to soil, water, and climatic conditions
- Can confirm and adjust assumptions made with soil moisture depletion method

Location	(bar)
Air above tree	-95
Air near leaf	-70
Air in leaf	-14
Xylem in leaf	-12.5
Xylem in scaffold	-10.5
Xylem in trunk-	-9.0
Xylem in root	-0.6
Soil	-0.3

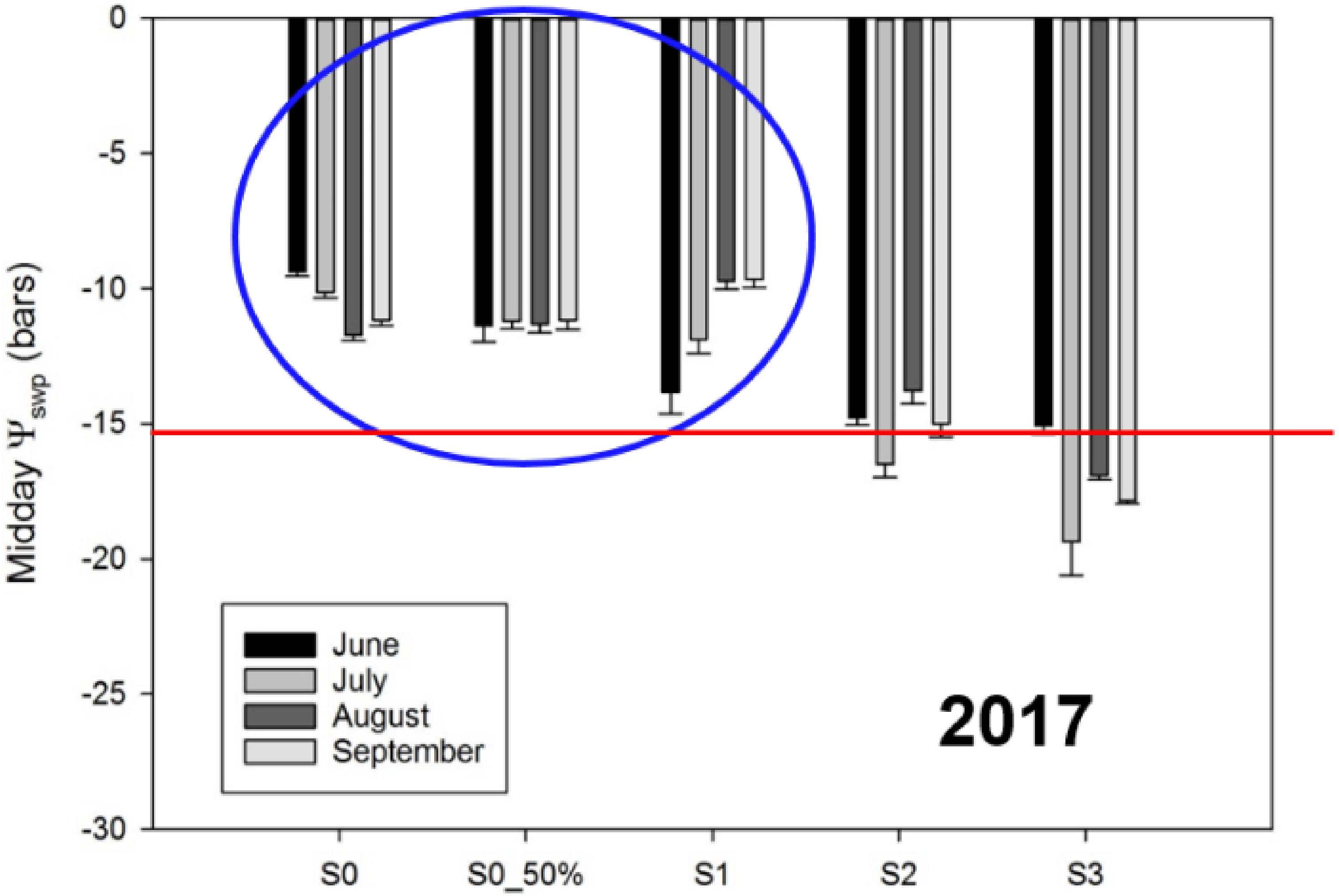
Water Budgeting and Tree Water Status



- At field capacity, in moist soil mid-day SWP values between -9 and -11 bars
- As the soil dries, mild stress develops between -11 and -14 bars
- Maintaining trees between -15 and -18 bars during Stage 2 and during post-harvest can save water without adverse yield impacts

Salinity, drainage, and tree vigor influence stress levels

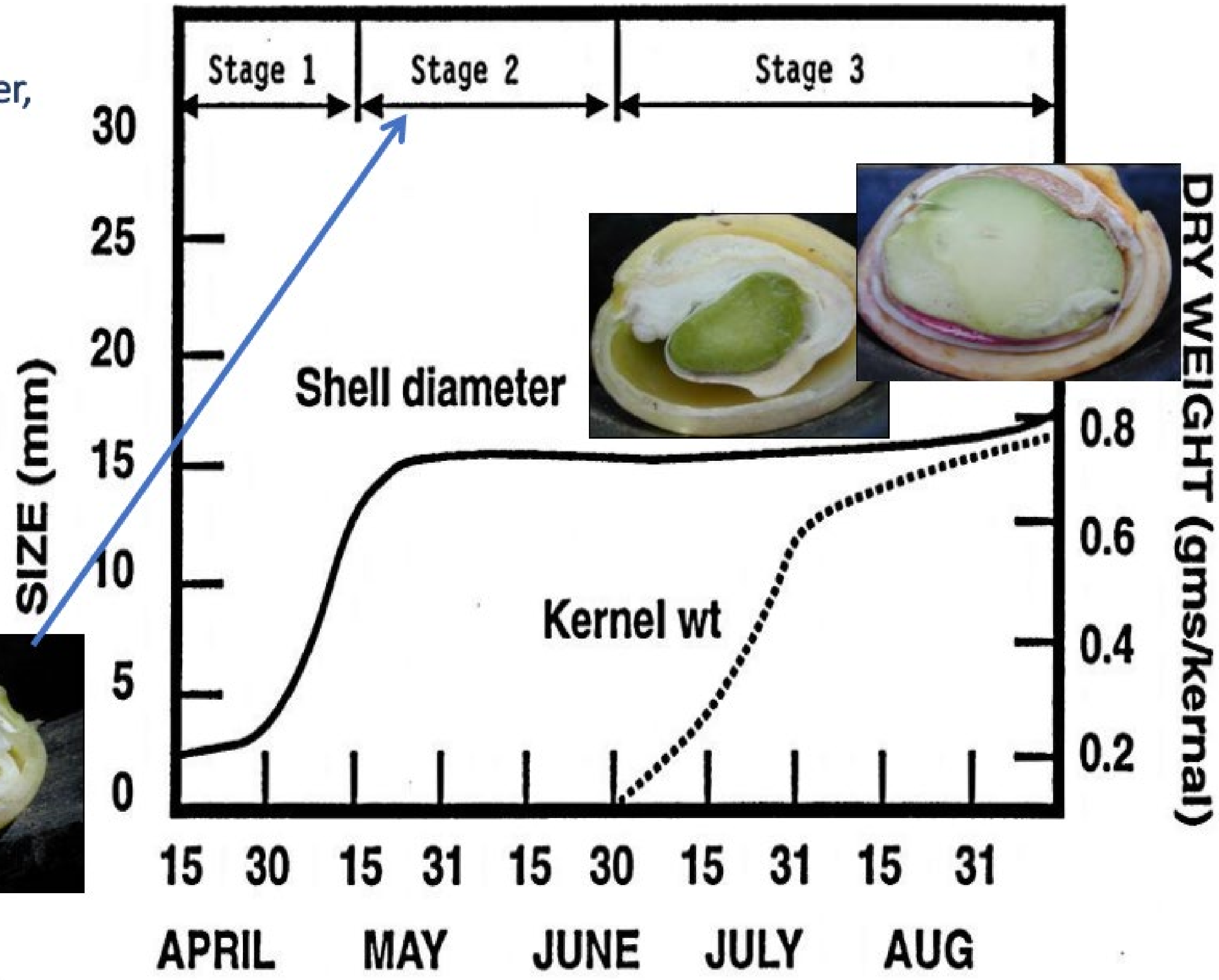
Stressed trees will have a more negative baseline



Marino et al. 2018

Nut Development and Regulated Deficit Irrigation Timing

(Dave Goldhamer, Pistachio Production Manual 2008)



- Do not stress during Stage 1 shell expansion and Stage 3 nut fill
- Deficit irrigation ~50% ETc during Stage 2
- Post harvest deficit ~25% ETc *no neg. impacts on Kerman, but more research needed on earlier harvested varieties

http://ucmanagedrought.ucdavis.edu/Agriculture/Crop_Irrigation_Strategies/Pistachios/

Bi-Weekly Pistachio Water Budget Example with Deficit Applied

Growth Stage	Approx. Phenology	Timeline	Kc	ETo	ETc	Accum. ETc	Rain	Rain accum	Deficit % ETc	Hours irrigation @ 0.13 in/hr/wk	Accum deficit
Stage 1	Bloom	Apr 1-15	0.07	2.71	0.19	0.17	1.0	1.00	none	none	none
	Leafout	Apr 16-30	0.43	3.49	1.50	1.69	1.7	2.7	none	none	none
	Shell Expansion	May 1-15	0.68	3.73	2.53	4.23	0.5	3.2	none	none	1.0
Stage 2	Shell Hardening	May 16-31	0.93	3.28	3.05	7.28	0.3	3.5	0.5	15	2.4
		Jun 1-15	1.09	5.09	5.55	12.83	0		0.5	22	2.8
		Jun 16-30	1.17	5.19	6.08	18.91	0		0.5	25	3.0
Stage 3	Nut Fill	Jul 1-15	1.19	5.32	6.33	25.24	0		none	51	0.0
		Jul 16-31	1.19	5.6	6.66	31.90	0		none	54	0.0
	Nut Fill/Shell Split	Aug 1-15	1.19	4.91	5.84	37.74	0		none	47	0.0
	Shell Split	Aug 16-31	1.12	4.71	5.28	43.02	0		none	43	0.0
	Hull Slip	Sep 1-15	0.99	4.19	4.15	47.18	0		none	34	0.0
Harvest		Sep 16-30	0.87	3.44	2.99	50.17	0		0.25	6	2.2
Post-Harvest		Oct 1-15	0.67	2.84	1.90	52.07	0		0.25	4	1.4
		Oct 16-31	0.5	2.74	1.37	53.44	0		0.25	3	1.0
		Nov 1-15	0.35	2.04	0.71	54.16	0		0.25	1	0
										~37" applied water	14" Accum deficit

How to manage irrigation during drought?

- Estimate of crop evapotranspiration (ET) since last irrigation or rainfall
- Root zone soil water storage
- Irrigation system application rate, evaluation, and maintenance
- Pistachio thresholds for moisture stress
- **Saline locations**

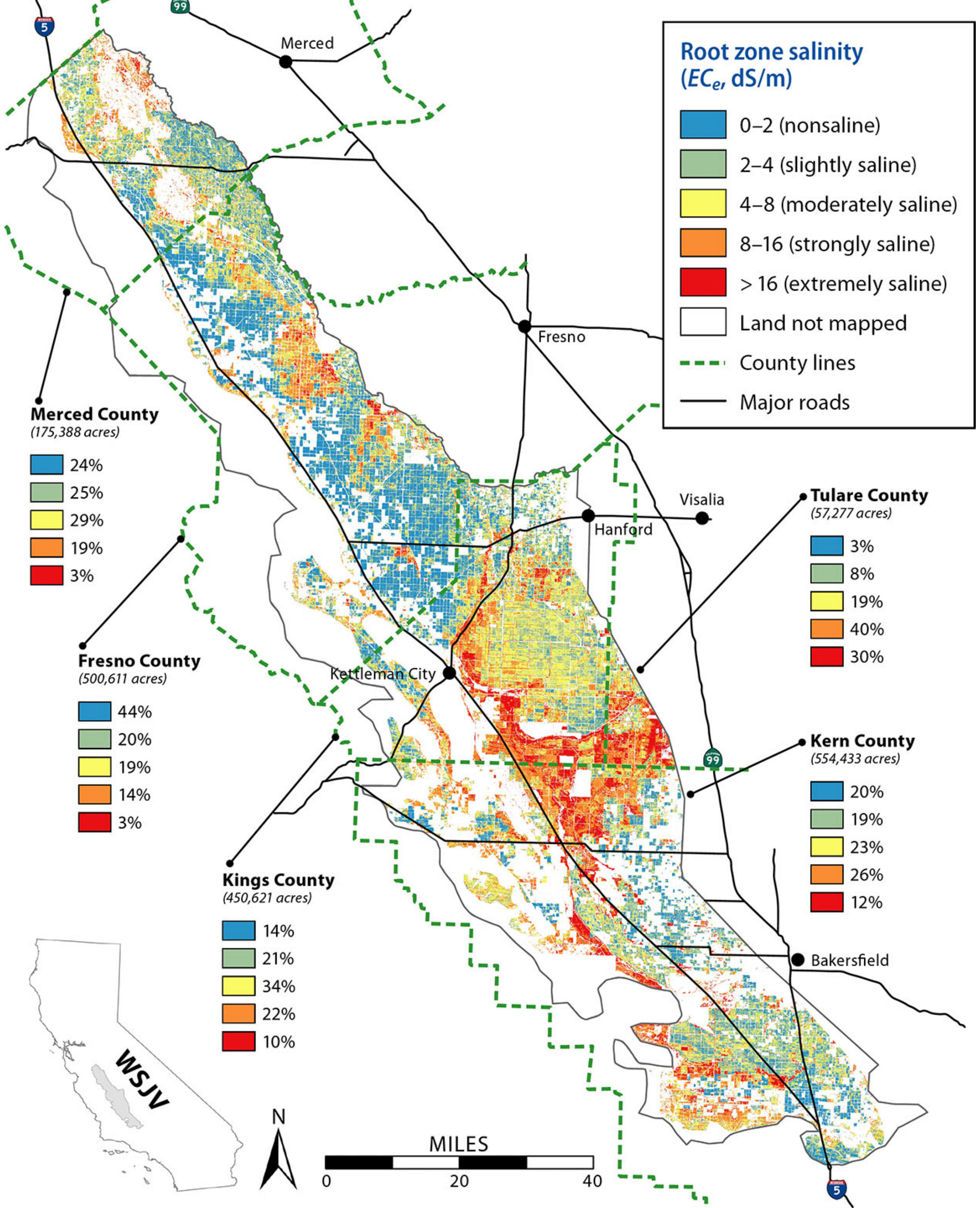
Salinity levels by county

Irrigation water exceeding 5-6 dS/m EC not viable for the long-term, especially if salinity/sodic conditions are coupled with poor soil drainage

Acres with soil EC 4 dS/m or higher:

- Fresno > 34%
- Kings > 66%
- Kern > 61%
- Merced > 51%
- Tulare > 89%

Scudiero et al. 2017

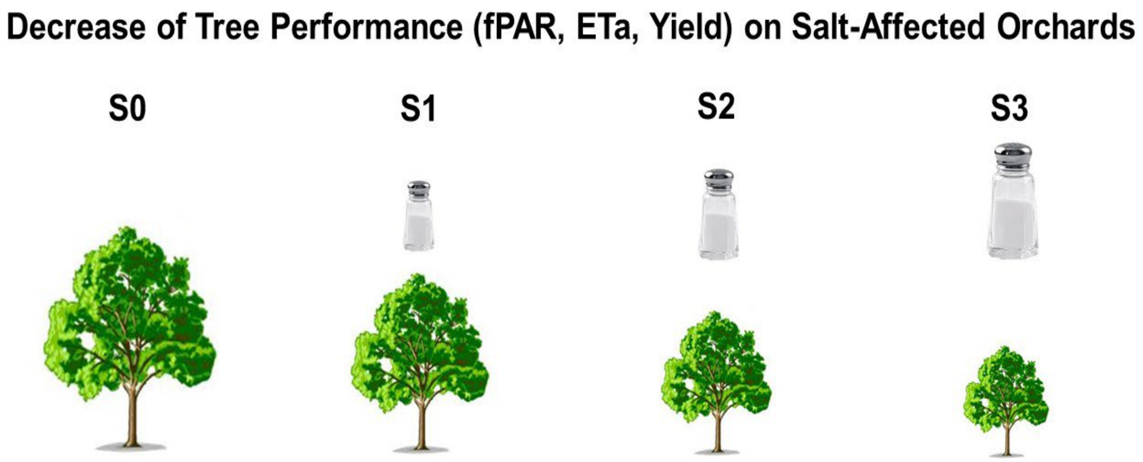


Drought and other factors contribute to salinity problems

- High ET and low precipitation levels to accomplish leaching concentrate salts in the rootzone of crops
- Poor quality water
- Excessive fertilizers and composts

Salinity Influence on Canopy, Water Use, and Yield

- Salt affected soil resulted in lower yields but also ~30% lower water use
- Despite lower water in-season requirements, additional water is needed to leach salts from the rootzone during dormancy



ECe dS/m	2	4-5	6-8	9-11
fPAR %	75	60	45	34
Yield (lbs/ac)	4,094	3,121	2,991	1,925
Seasonal Cumulative ETa	42.6	38.2	31.6	29.6
WP (lbs./in.)	96.1	81.7	94.6	65.0
Relative WP Gain/Reduction (%)	-	-15%	+2%	-32%

Zaccaria et al. unpublished, Marino et al. 2020

Salinity Management: Winter Leaching

Leaching Requirement	soil average rootzone dS/m				
	2	3	4	5	6
Depth of water (in) to lower EC to 1.5 dS/m	2	6	10	14	18

Early to late winter:

- 1st fill profile to field capacity (3-6 inches over 3-4 days), allow 2-4 days drainage
- 2nd begin leaching applications 1 inch at a time for a total 6-12 inches dependent on soil texture, EC level of the rootzone, the final salinity goal, and the EC of the reclamation water

- keep irrigation sets to less than 24 hours to avoid the risk of soil saturation and *Phytophthora.*

$$D_w = (k \times D_s \times EC_{ei}) \div EC_{ef}$$

where:

D_w = depth of water infiltrated (feet),
D_s = depth of soil to be reclaimed (feet),
k = 0.45 for organic soils, 0.30 for fine-textured soils, 0.10 for coarse-textured soils,
EC_{ef} = final soil salinity desired,
EC_{ei} = initial soil salinity.

Summary: Water Management Strategies During Drought

- Pistachio are drought tolerant, but severe shortages can result in high % blanks, low shell splitting, and reductions in overall yield
- A water budget compares in season ET to applied water, in-season rain and soil storage
- Free online resources available to schedule and track irrigation applications throughout the year
- Soil moisture monitoring can lead to improved irrigation decisions on frequency and duration
- Irrigation system evaluations and routine maintenance are critical
- Midday SWP quantifies how an orchard is responding to soil, water, and climatic conditions, can confirm assumptions made by water budget and moisture depletion approaches
- Regulated deficit irrigation at different stages in crop development may significantly reduce water use and mitigate water stress impacts on yield
- Consider site specific information about soil texture and salt levels when scheduling irrigation

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Insights: Water & Drought Online Seminar Series

For further resources, visit us at
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