2018 | THE ALMOND CONFERENCE

MORE CROP PER DROP

ROOM 308-309 | DECEMBER 5, 2018

california almonds
Almond Board of California

growing ADVANTAGE
The Almond Conference

AGENDA

- **Phoebe Gordon**, UCCE Madera, moderator
- **Luke Milliron**, UCCE Butte
- **Ken Shackel**, UC Davis
- **Daniele Zaccaria**, UCD-LAWR

WUE not just H_2O

Yield: Beyond Water

Luke K. Milliron

UC Cooperative Extension

Farm Advisor Butte, Tehama, and Glenn Counties

December 5, 2018

Almond Conference

For the latest from UCCE orchard farm advisors…

- **Newsletters:** Sacramento Valley: Almonds, Walnut and Prunes

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- **Podcast:** Growing the Valley

  UC CE | University of California Agriculture and Natural Resources | Cooperative Extension

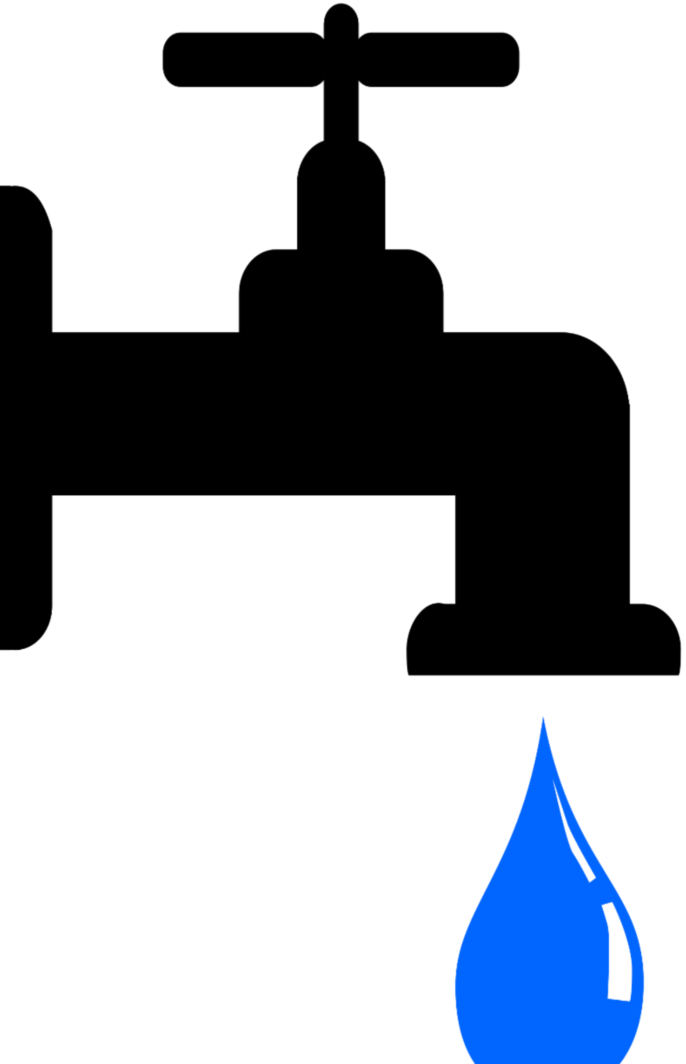
  GrowingTheValleyPodcast.com

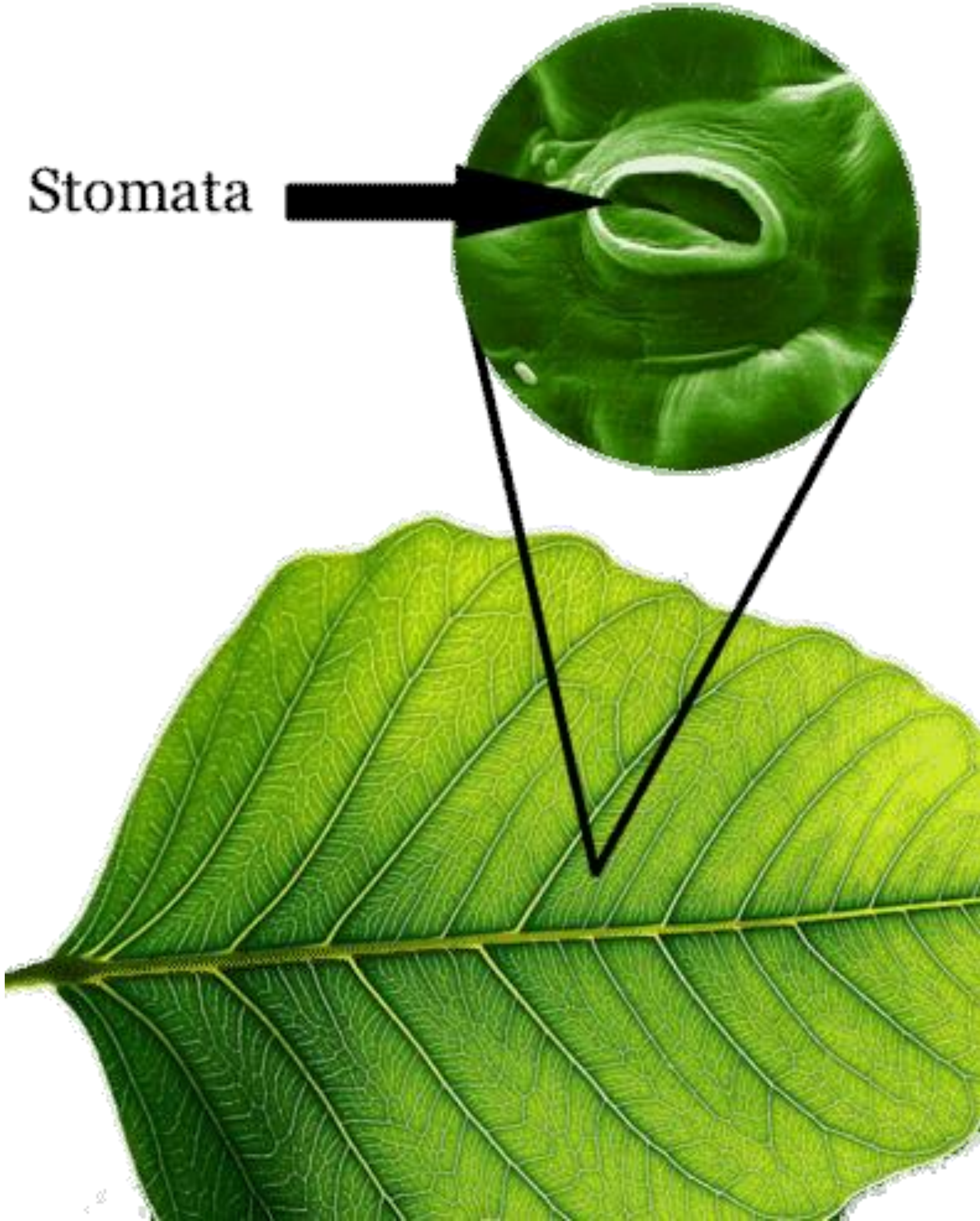
  Subscribe: **Apple iTunes** and **Google Play Music**

- **Website:** SacValleyOrchards.com

"Water is life!"

– Ken Shackel (UC Davis)





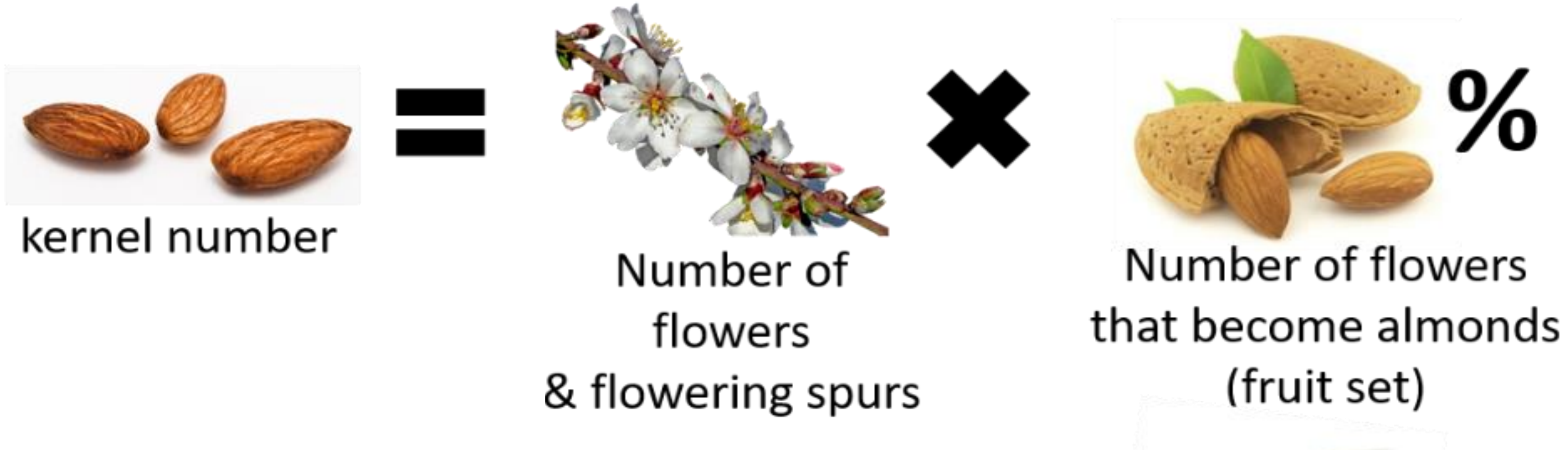
Yield: Beyond Water

Yield =  kernel number × 

weight per kernel

Yield =  kernel number ×  weight per kernel

 kernel number =  Number of flowers & flowering spurs ×  % Number of flowers that become alm (fruit set)



Firstly follow best practices for sustaining good fruit set (%)

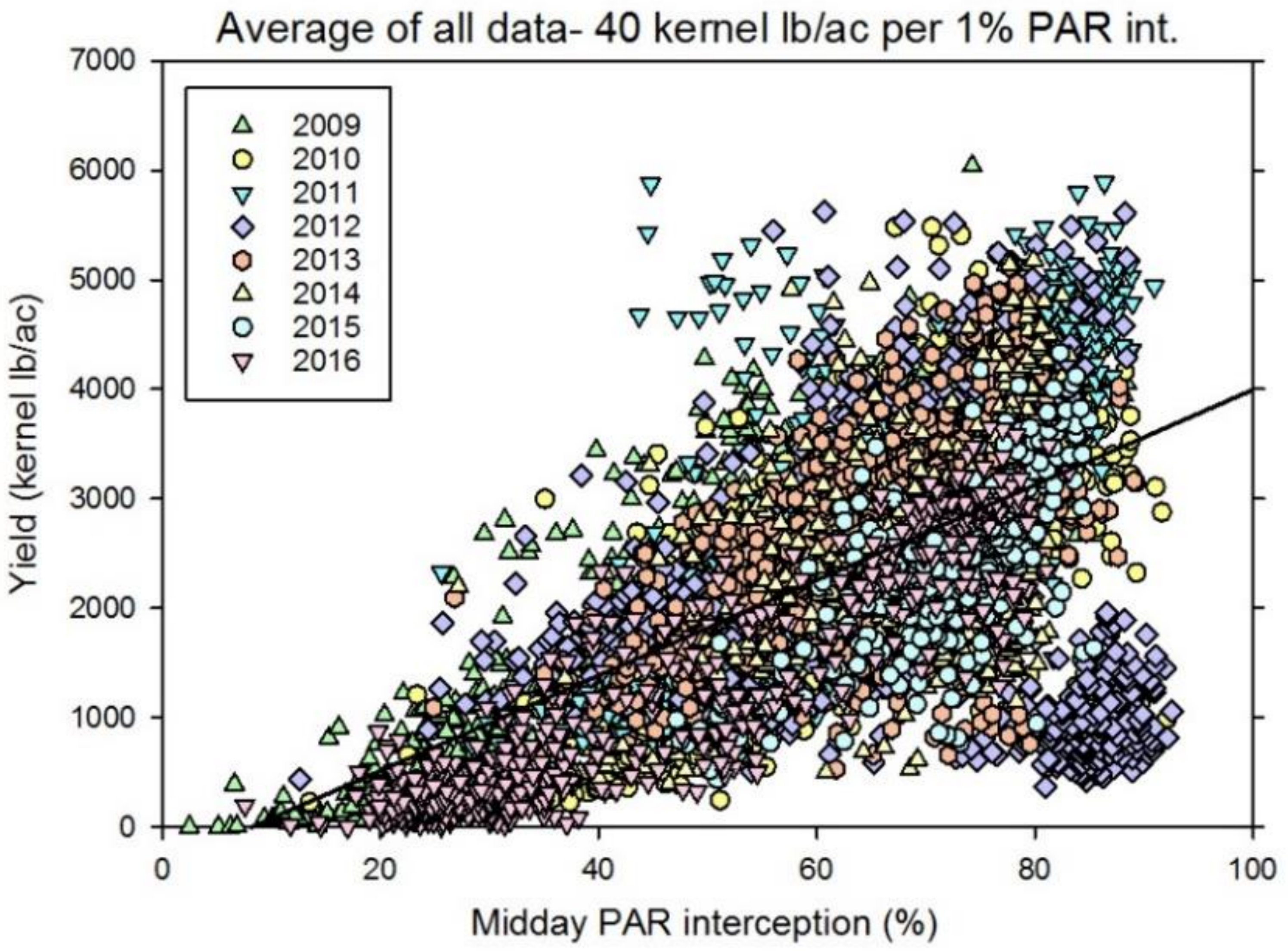
- e.g. 25% early & 25% late pollinizer cv., and 2-3 hives/acre

Encourage more flowers in subsequent years…

- Plant and manage for almond canopies with 80% light interception
- Protect next year's flowering buds (biotic & abiotic stressors)

Encourage more flowering spurs in subsequent years…

Plant and manage for canopies with 80% light interception



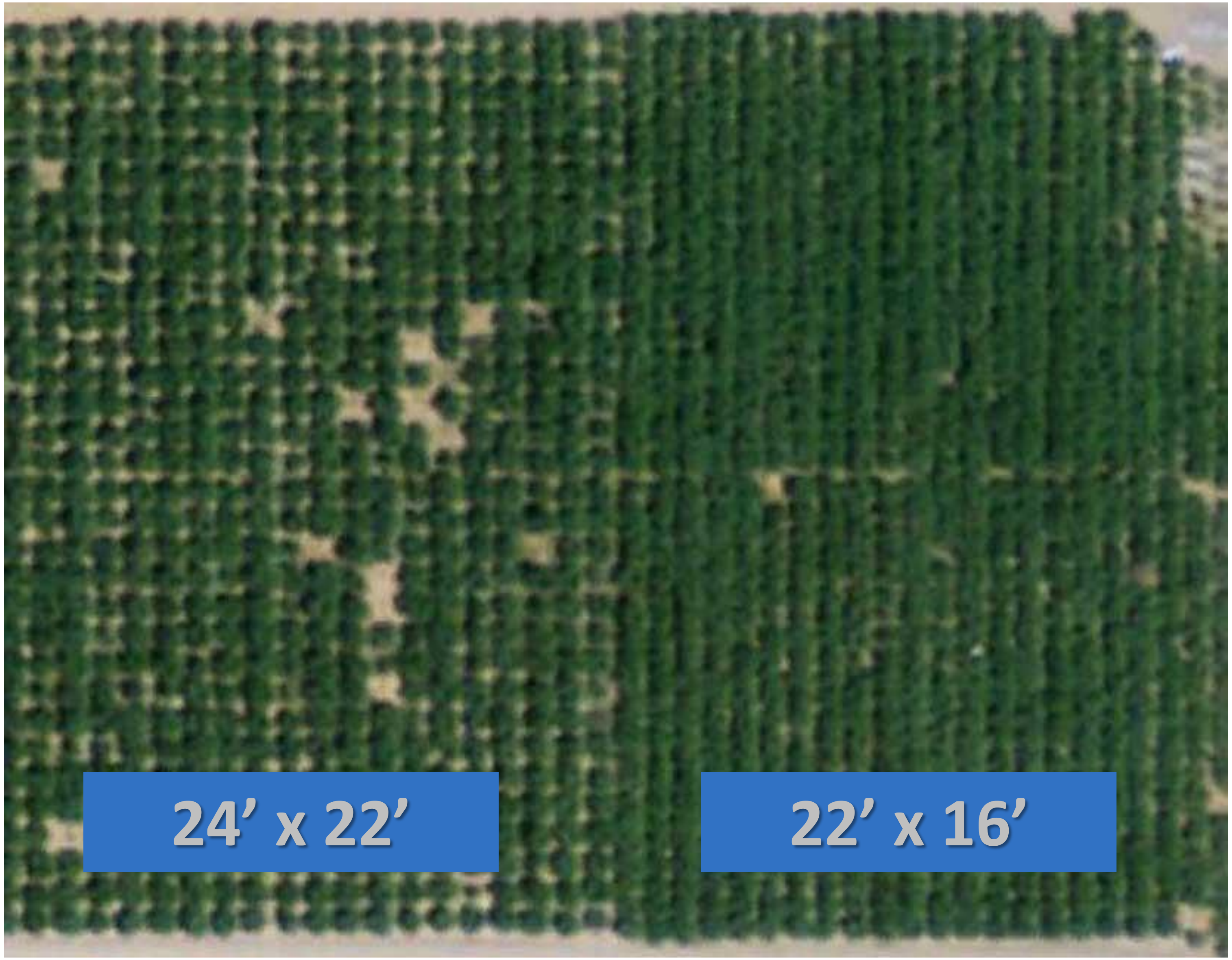
Bruce Lampinen's lab found on average **40 kernel lbs/1% light intercepted**)

39% interception (2000 kernel lbs/ac potential

50% interception (2500 kernel lbs/ac potential

80% interception (4000 kernel lbs/ac potential

90% interception (4500 kernel lbs/ac potential



Nickels Soil Lab. Arbuckle, CA

Franz Niederholzer, UCCE Colusa and Sutter/Yuba

Plant and Mange for the ‘80/20 Rule’

- Minimize pruning after 2nd year of tree training
- Appropriate rootstock/ spacing combination for the site

Yield: Beyond Water

Avoid:

- –Nutrient deficiencies
- –Severe pest and disease infestations

Nitrogen Fertilizer: within a year of changes, yield differences can appear

Annual N Treatment (N/acre)	2008 Kernel yield (lb/acre)	2009 Kernel yield (lb/acre)	2010 Kernel yield (lb/acre)	2011 Kernel yield (lb/acre)
125 lb	3,500 a	2,700 a	2,800 a	3,800 a
200 lb	3,500 a	2,900 ab	3,400 b	4,300 b
275 lb	3,700 a	3,200 b	3,700 bc	4,600 c
350 lb	3,700 a	3,500 b	4,000 c	4,700 c

*Rounded to nearest hundred lbs

P. Brown, UC Davis

Potassium Fertilizer: can increase yield, especially following a heavy crop year

Treatment (K_2O/acre/ year)	1998 Kernel yield (lb/acre)	1999 Kernel yield (lb/acre)	2000 Kernel yield (lb/acre)
0 lb	800 a	4000 a	2400 a
240 lb	900 a	3800 a	2900 b
600 lb	800 a	4400 a	2900 b
960 lb	1000 a	4000 a	2800 b

*Rounded to nearest hundred lbs

Potassium deficiency linked to increased % spur death

Reidel, Weinbaum, Brown and Duncan, UC Davis

Protect next year's flowering spurs: Prevent defoliation and spur death

Mites

Rust

Hull Rot

Protect this season's crop from direct pest & disease losses
e.g. navel orangeworm (NOW) reject level

(Yield) lbs/Ac	% NOW (grade sheet)	% NOW (left in field)	Total % NOW damage	Good meats (lbs/ac)
2,500	0%	0%	0%	2,500
2,500	1%	1%	2%	2,450
2,500	2%	2%	4%	2,400
2,500	3%	3%	6%	2,350
2,500	5%	5%	10%	2,250
2,500	10%	10%	20%	2,000

Simulation of 2,500 yield/ac

Dani Lightle UCCE

Yield: Beyond Water

Good fruit set (%) practices

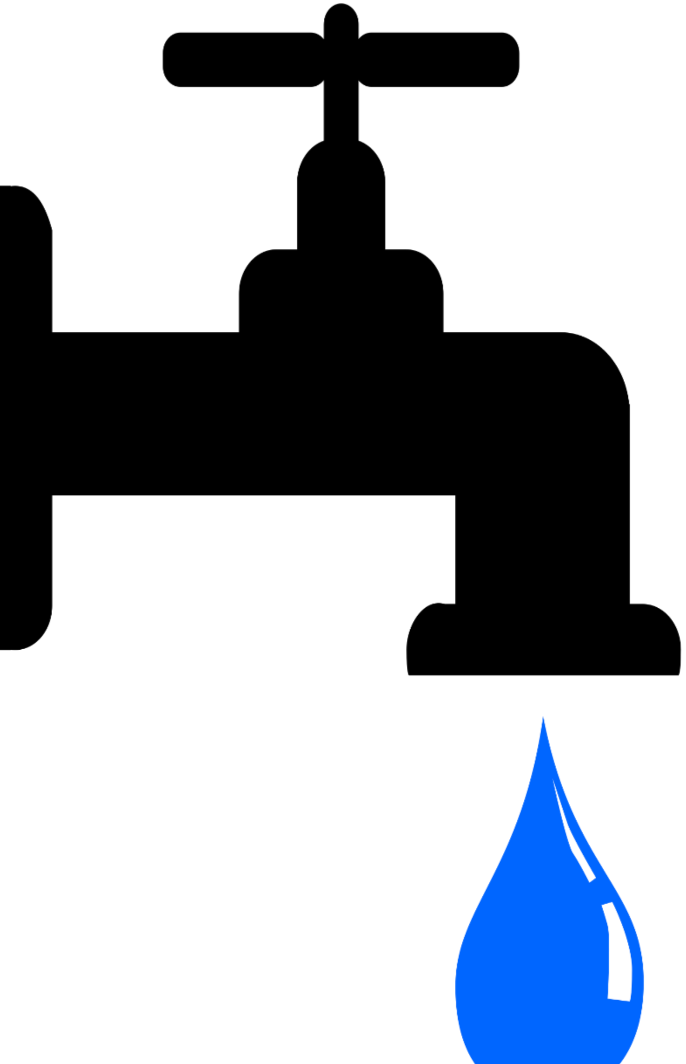
- Pollinizer coverage & bee health/density

Encourage more flowers in subsequent years...

- Plant and manage for almond canopies with 80% light interception
- Avoid nutrition stressors
- Prevent defoliation and spur death

Protect this season's crop from direct pest & disease losses

Never mind… it's all about water!



Thanks!

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SacValleyOrchards.com

Lysimeter Update: Whole Tree ET Response to Mild and Moderate Water Stress

Ken Shackel
Mae Culumber
Bruce Lampinen
Cooperating:
Alireza Pourreza
Florent Trouillas
Andrew McElrone
Jim Ayars

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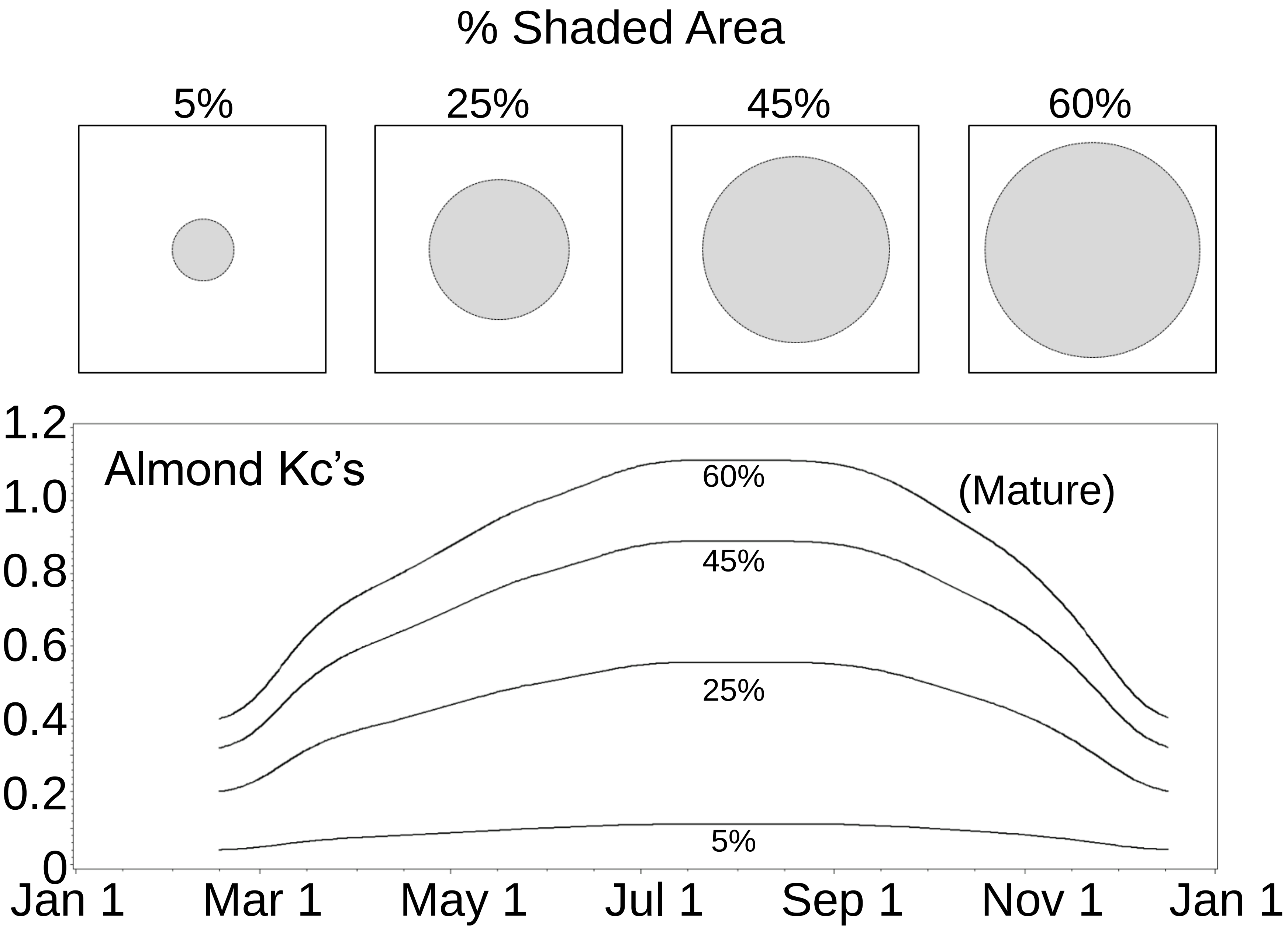
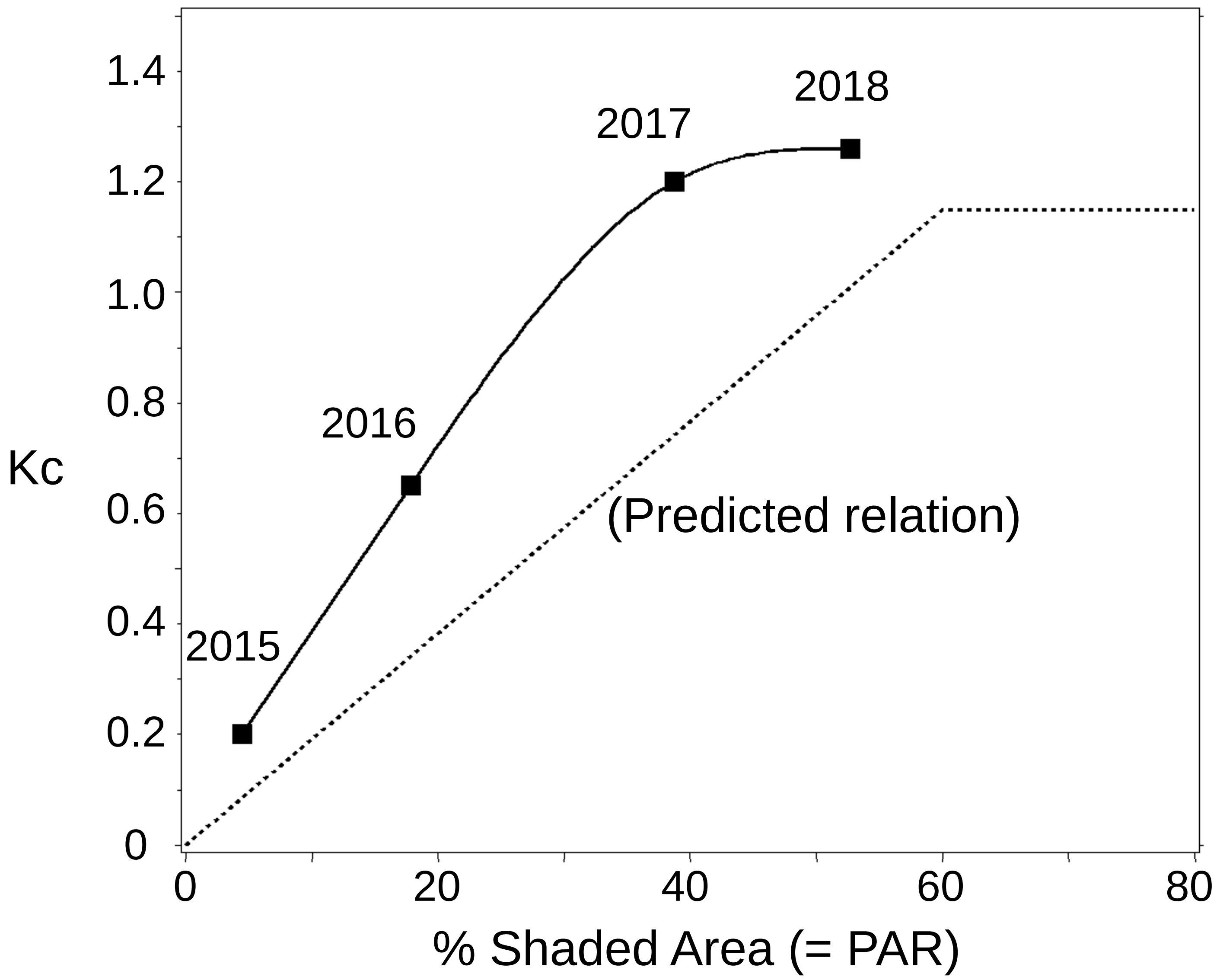
Lysimeter – big pot in the ground.
“Gold standard” for measuring ET, as long as the tree in the lysimeter is typical of the orchard.

For young (developing) orchards, % shaded area is used to determine how close Kc is to the 'mature' Kc (1.15).

A 'mature Kc' for almond is well established, based on accepted scientific methods, but not yet on lysimetry.



Annual increase in midsummer Kc and % shaded area

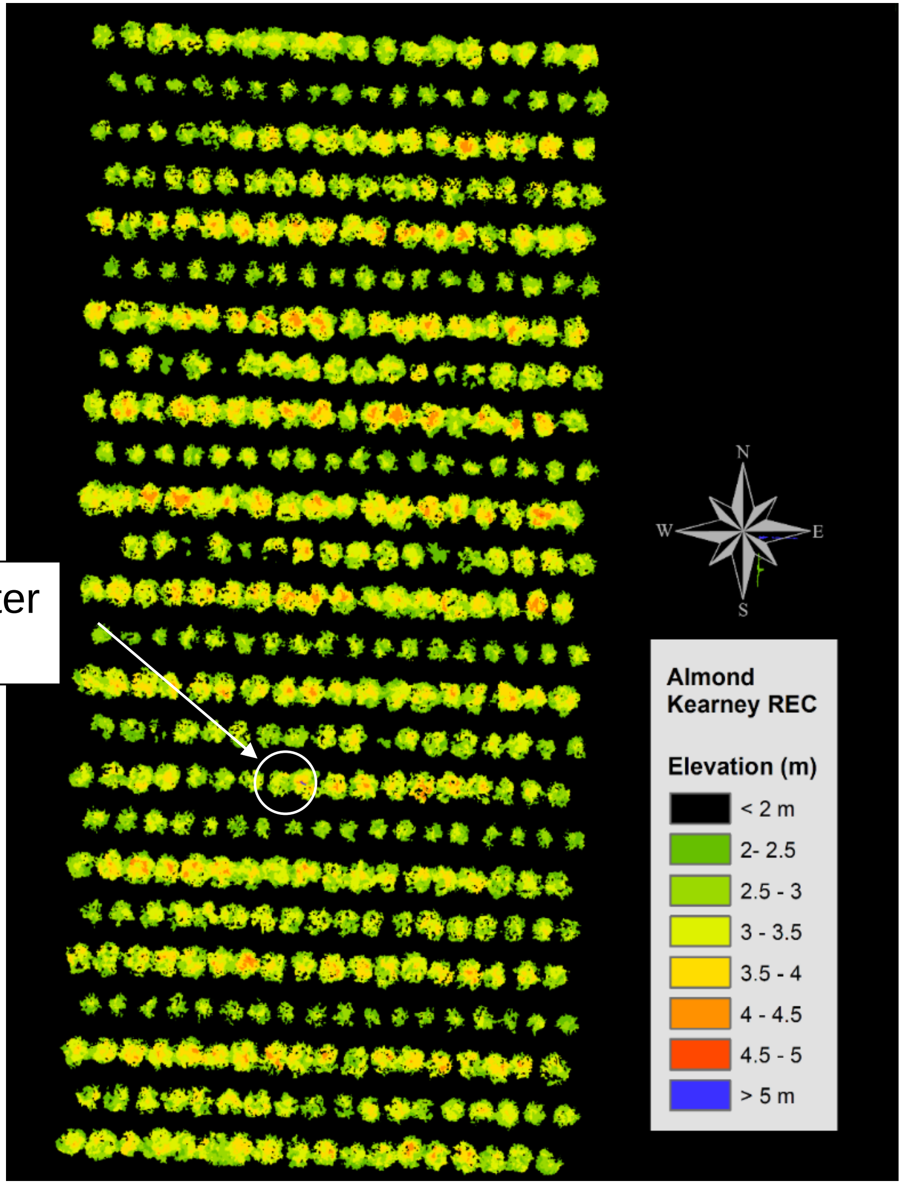


Year	Average Nonpareil Kernel Yield, #/ac
2017	770
2018	1450

Drone tree height map (A. Pourreza)

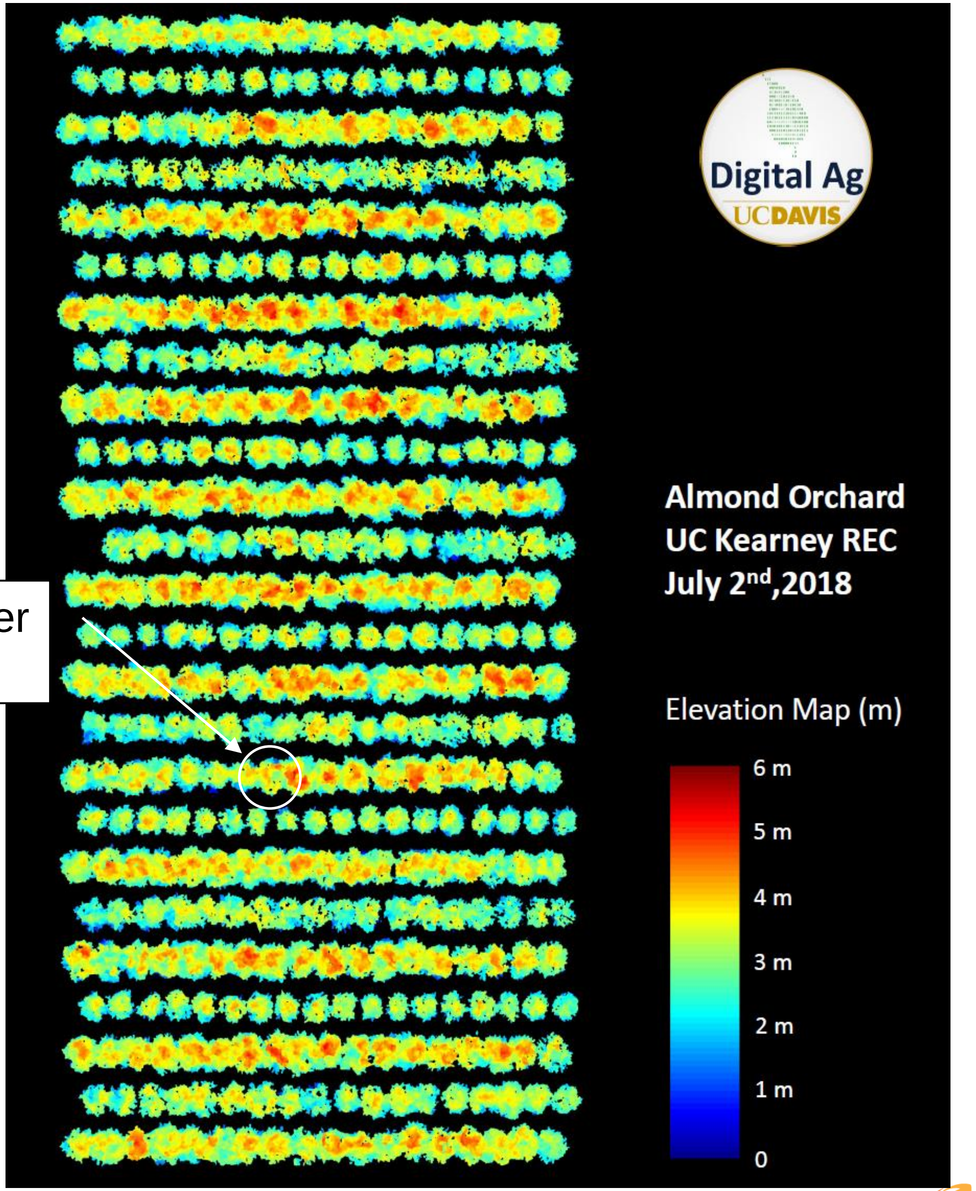
2017

(lysimeter tree)



2018

(lysimeter tree)



Drone tree height map (A. Pourreza)

Note:

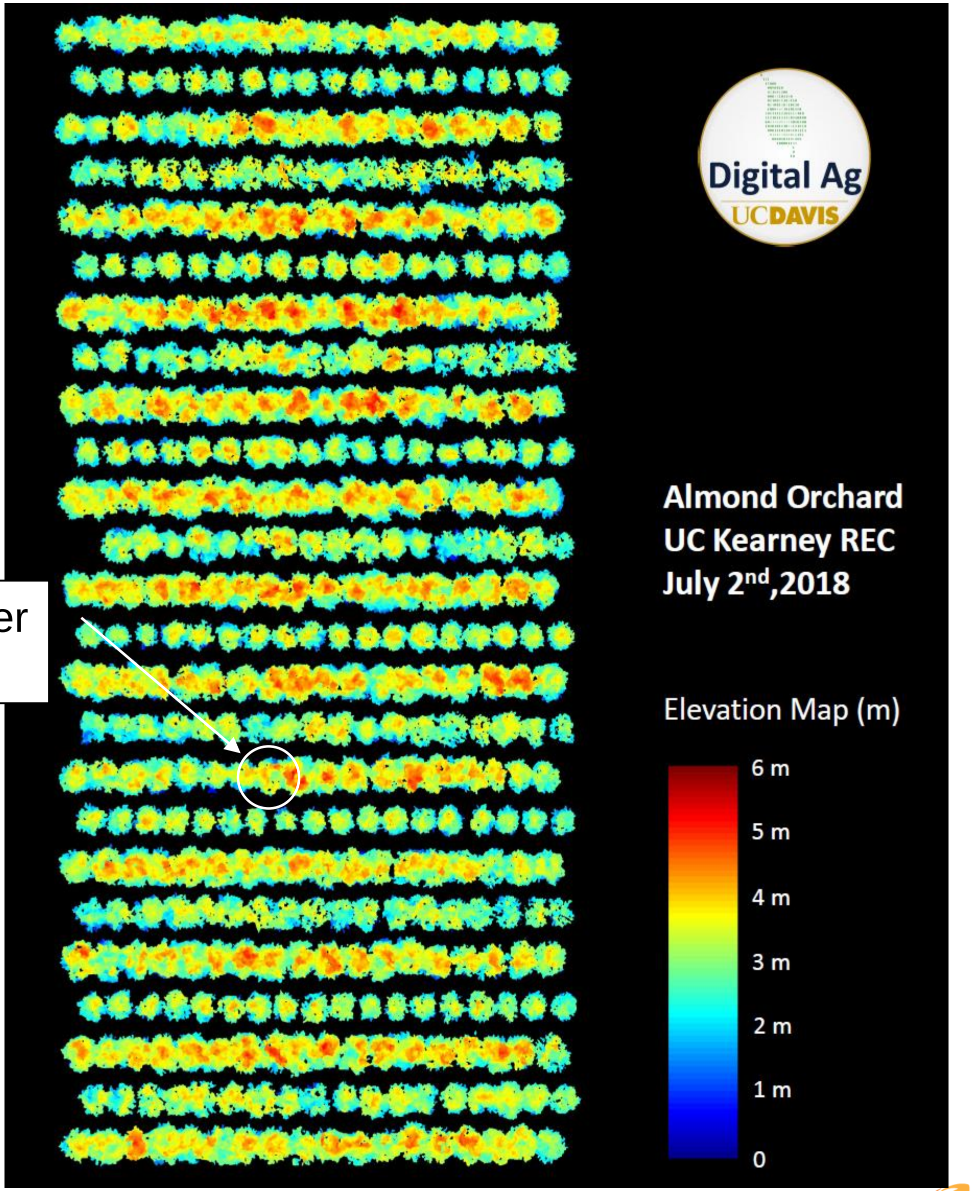
Every other row is a Nonpareil row, and pollinizer rows (Monterey, Wood Colony) are smaller trees than Nonpareil, especially Wood Colony.

Question: do bigger trees use more water?

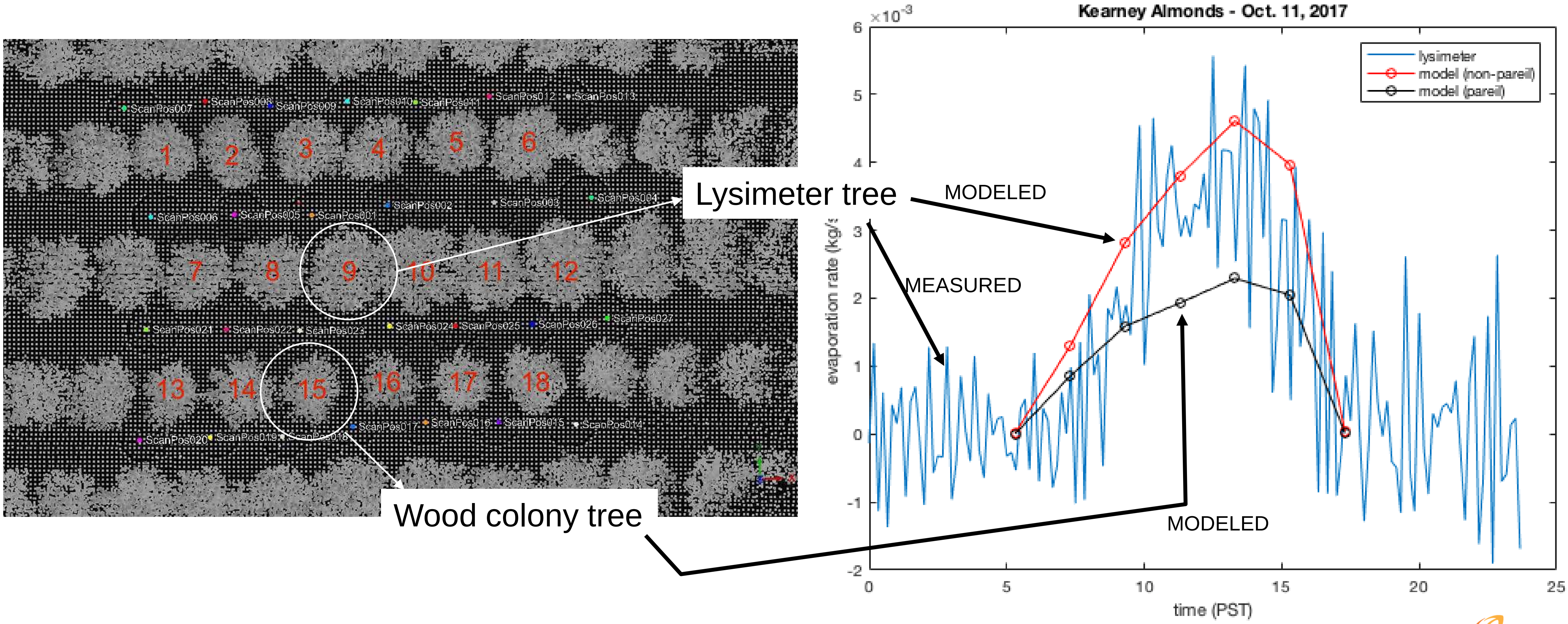
2018

NP
WC
NP
MR

(lysimeter tree)



Brian Bailey’s lidar map & ET model



Drone tree height map (A. Pourreza)

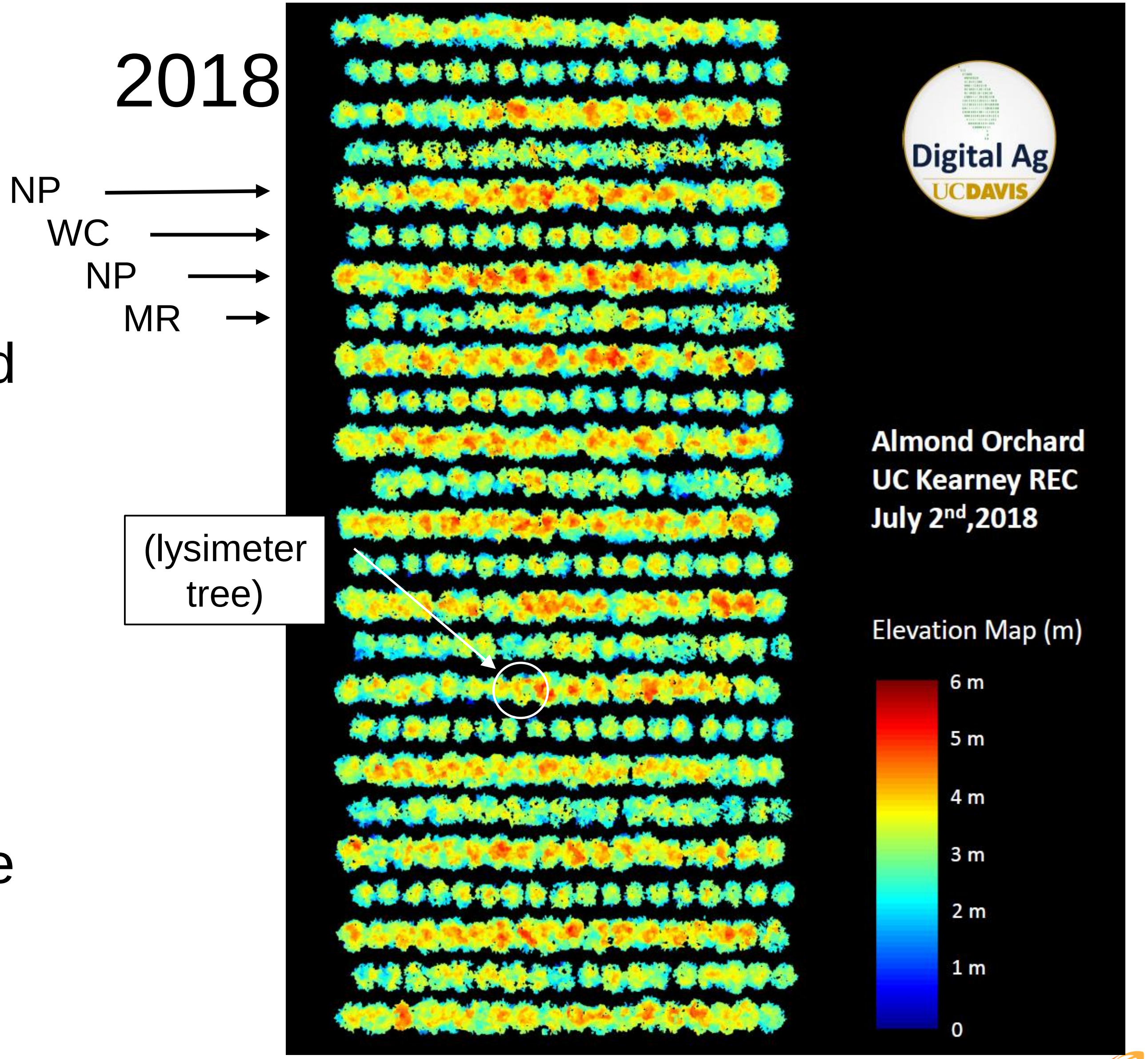
Note:

Every other row is a Nonpareil row, and pollinizer rows (Monterey, Wood Colony) are smaller trees than Nonpareil, especially Wood Colony.

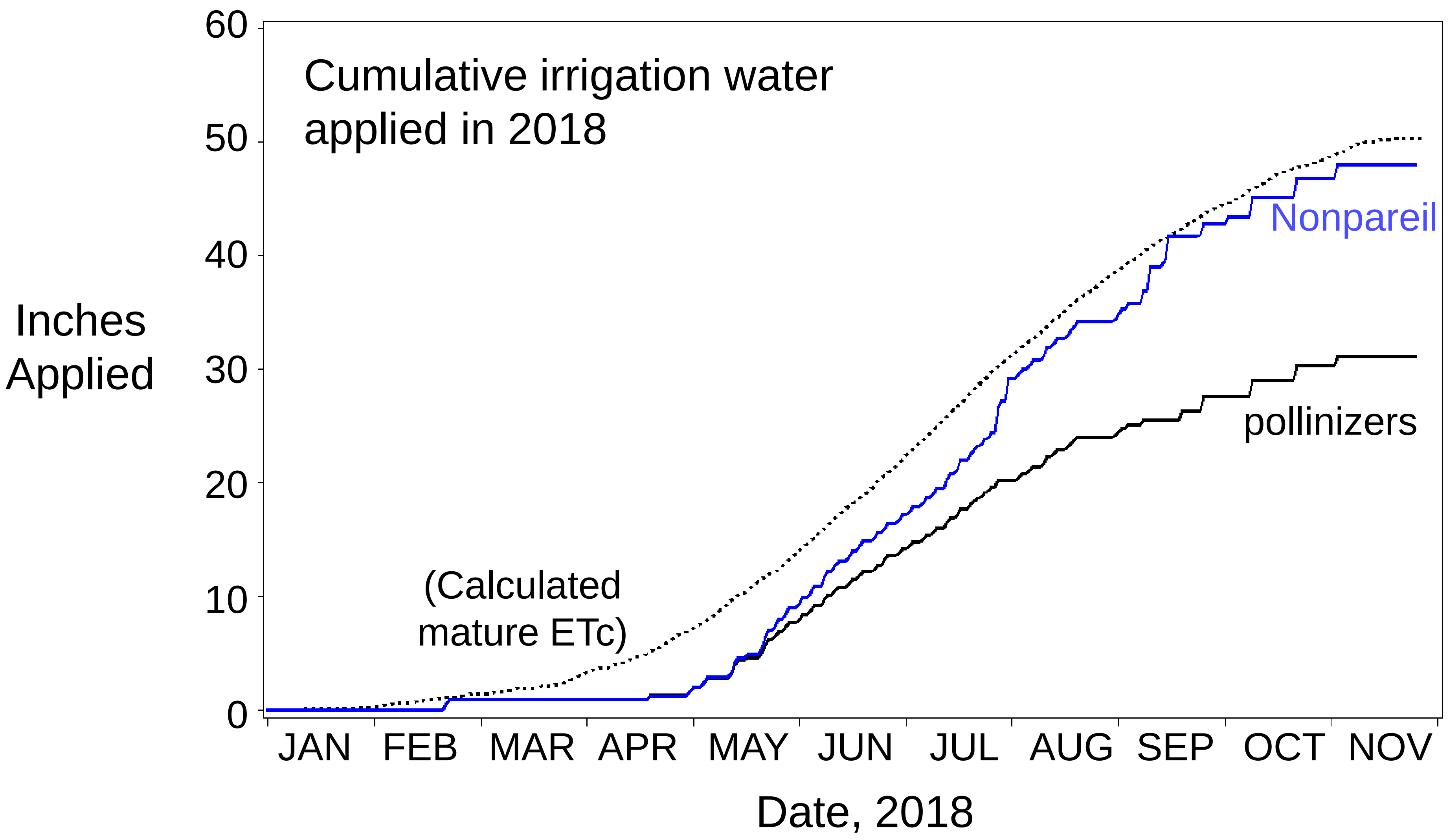
Question: do bigger trees use more water?

Probably yes.

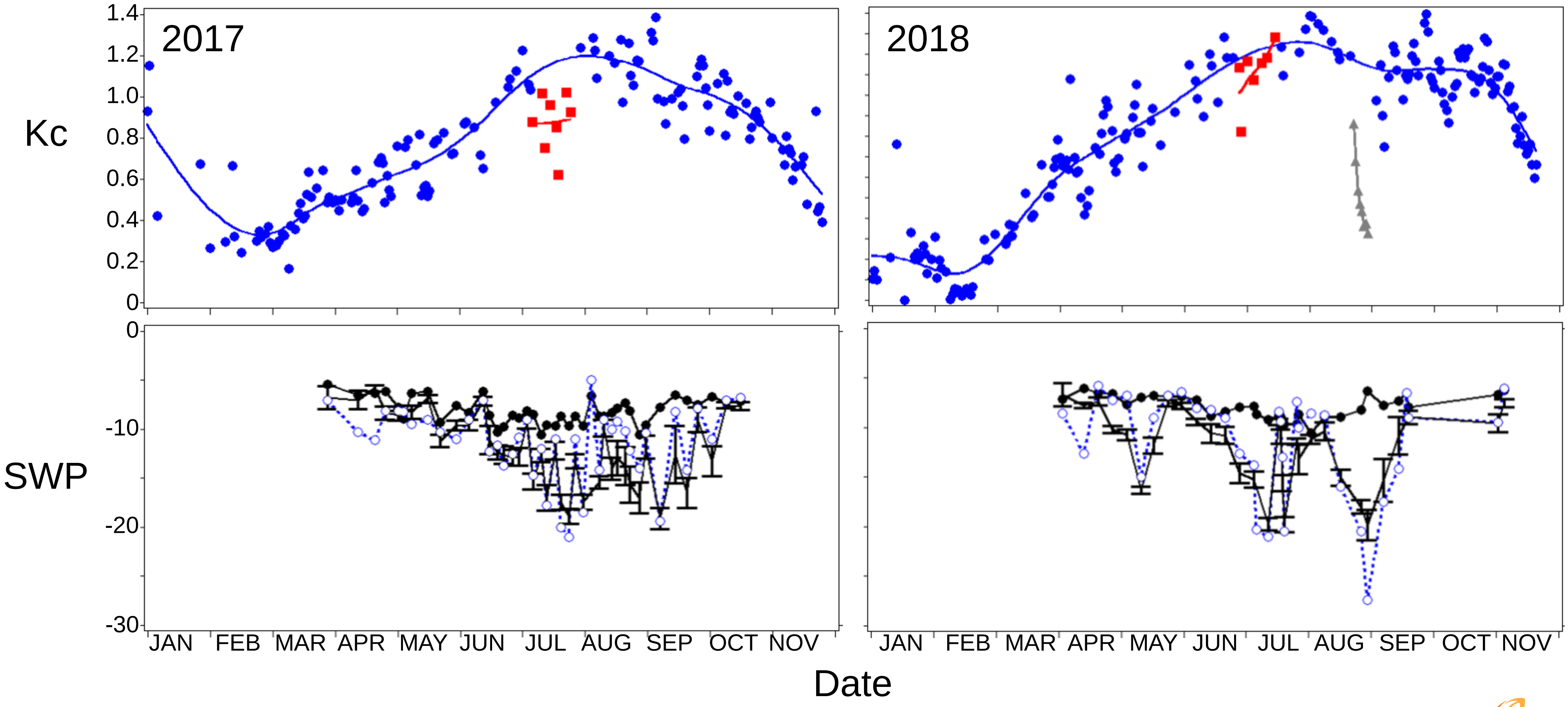
So, should we water all the trees the same, or favor the main variety?



Completed the design build-out of the double line drip irrigation system (7 drippers/tree) in Nonpareil, but stayed at 5/tree for the pollinizers.



In 2017 and 2018 there were periods of some water stress (e.g., hull split), and trees responded by using less water (Kc decreased).



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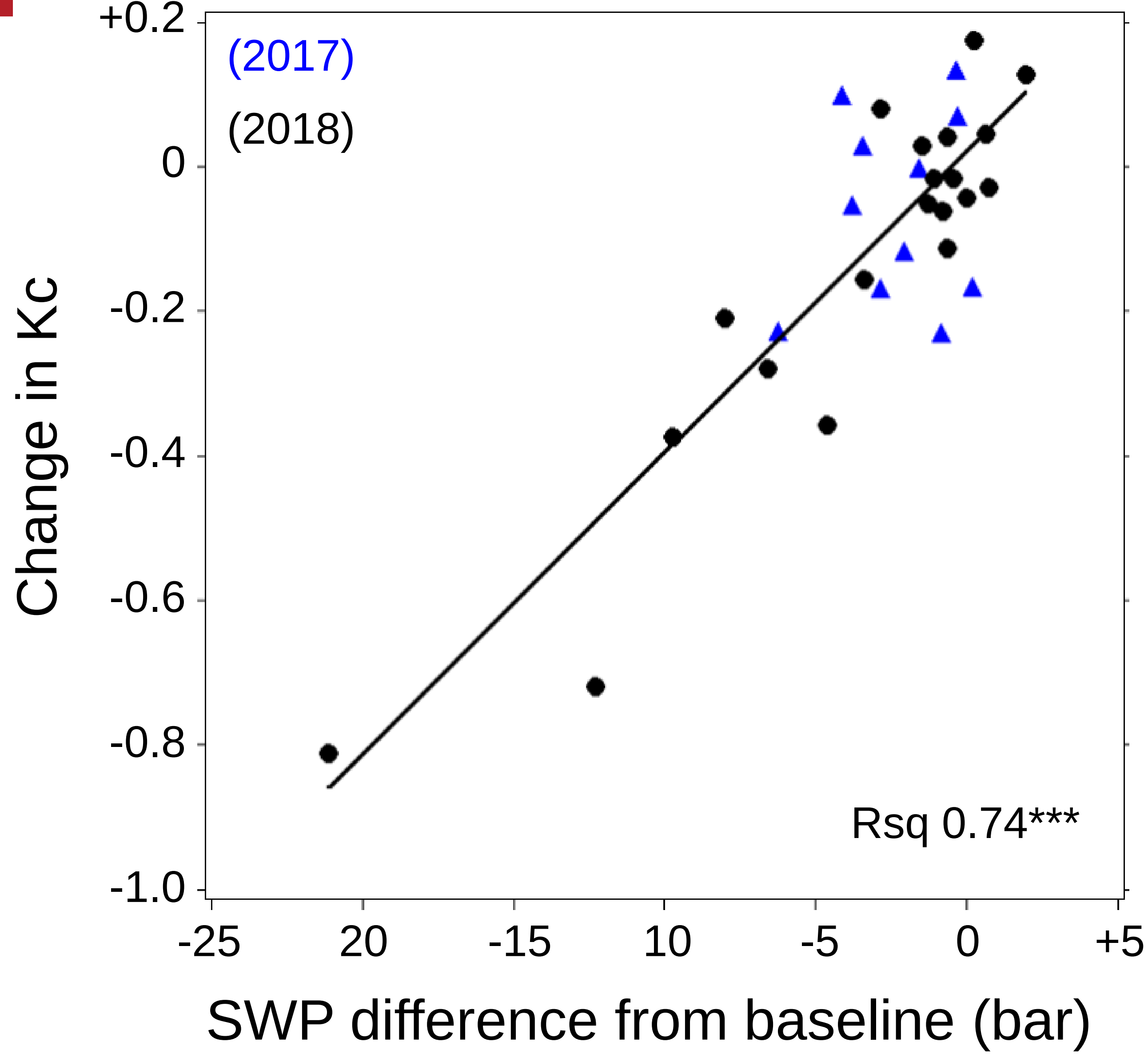
Strong reduction in Kc as SWP drops from baseline



Overall summary:

1) Young, rapidly growing almond trees increase in Kc about twice as fast as expected (based on the literature), reaching a 'mature' Kc at about 40% shaded area.
2) Sustained differential irrigation between the main variety and the pollinizers may be a good strategy.
3) Almonds show a strong reduction in ET with reductions in SWP at the tree level.

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More detail at the poster!

More Crop Per Drop: how the pressure chamber can help.

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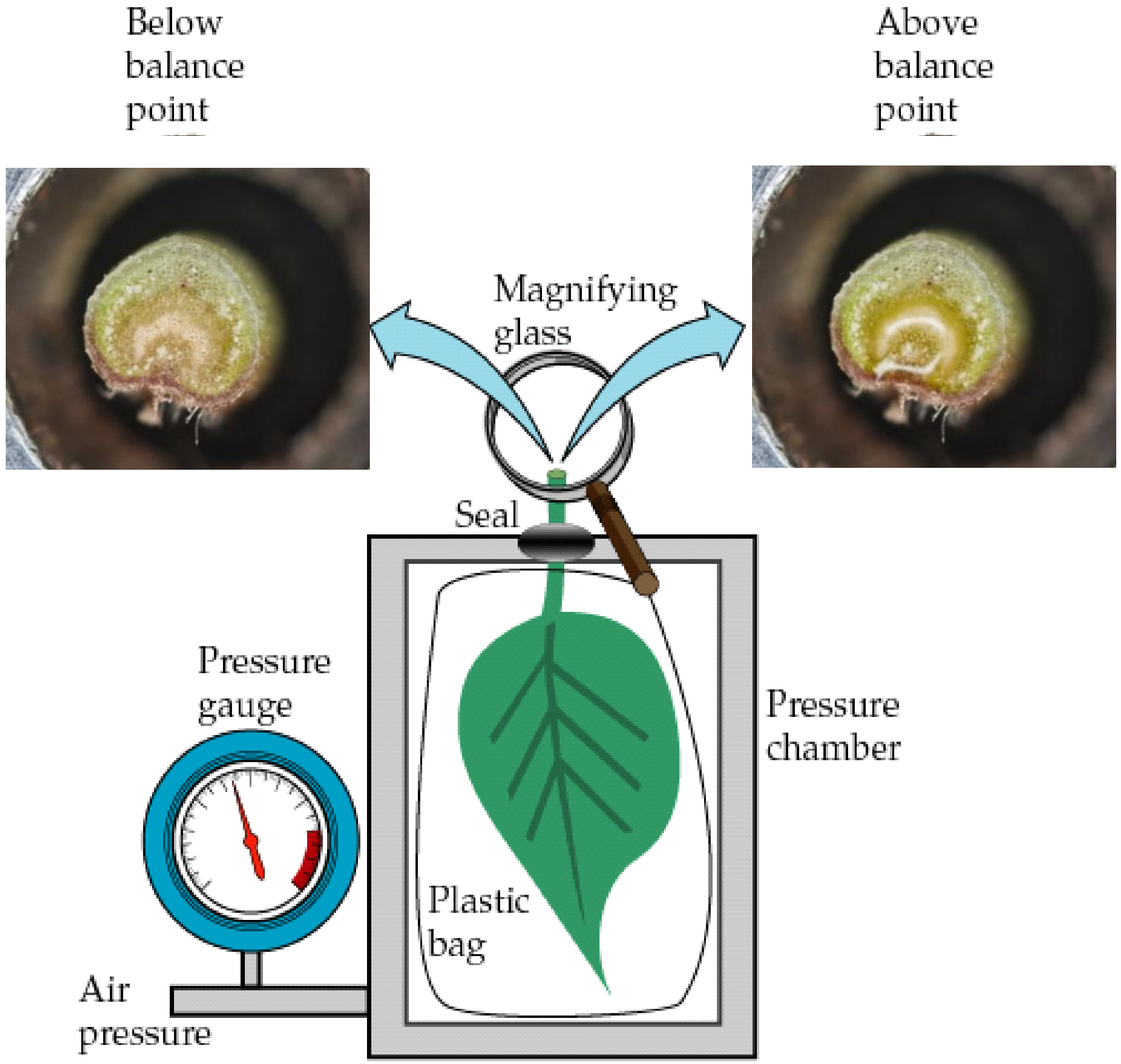
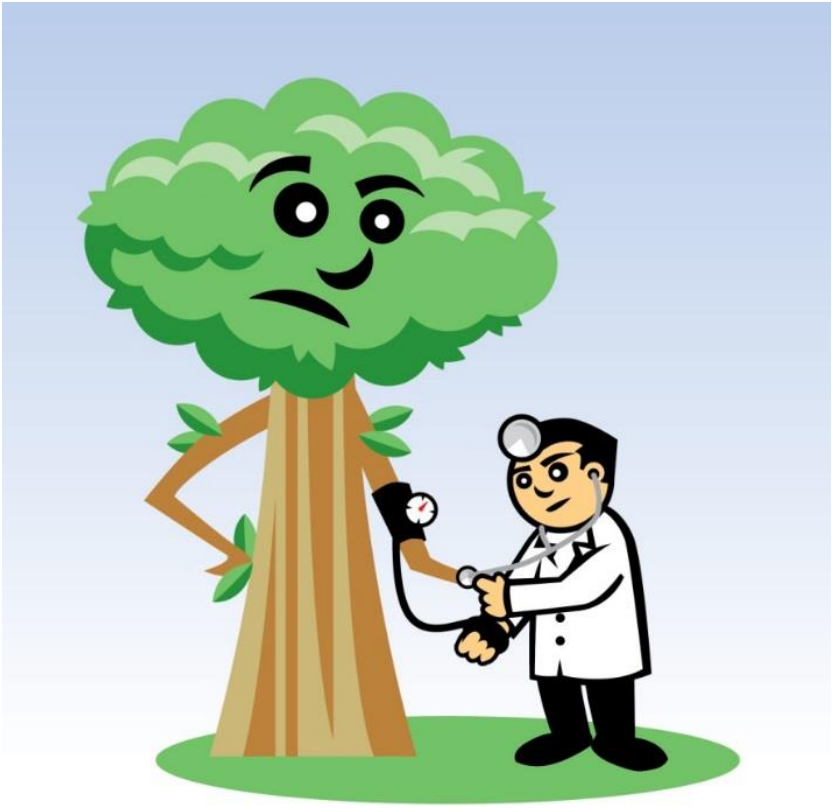
Pressure chamber method for measuring the level of water suction in the plant: midday stem water potential (SWP)



Like measuring the “blood pressure” of the plant

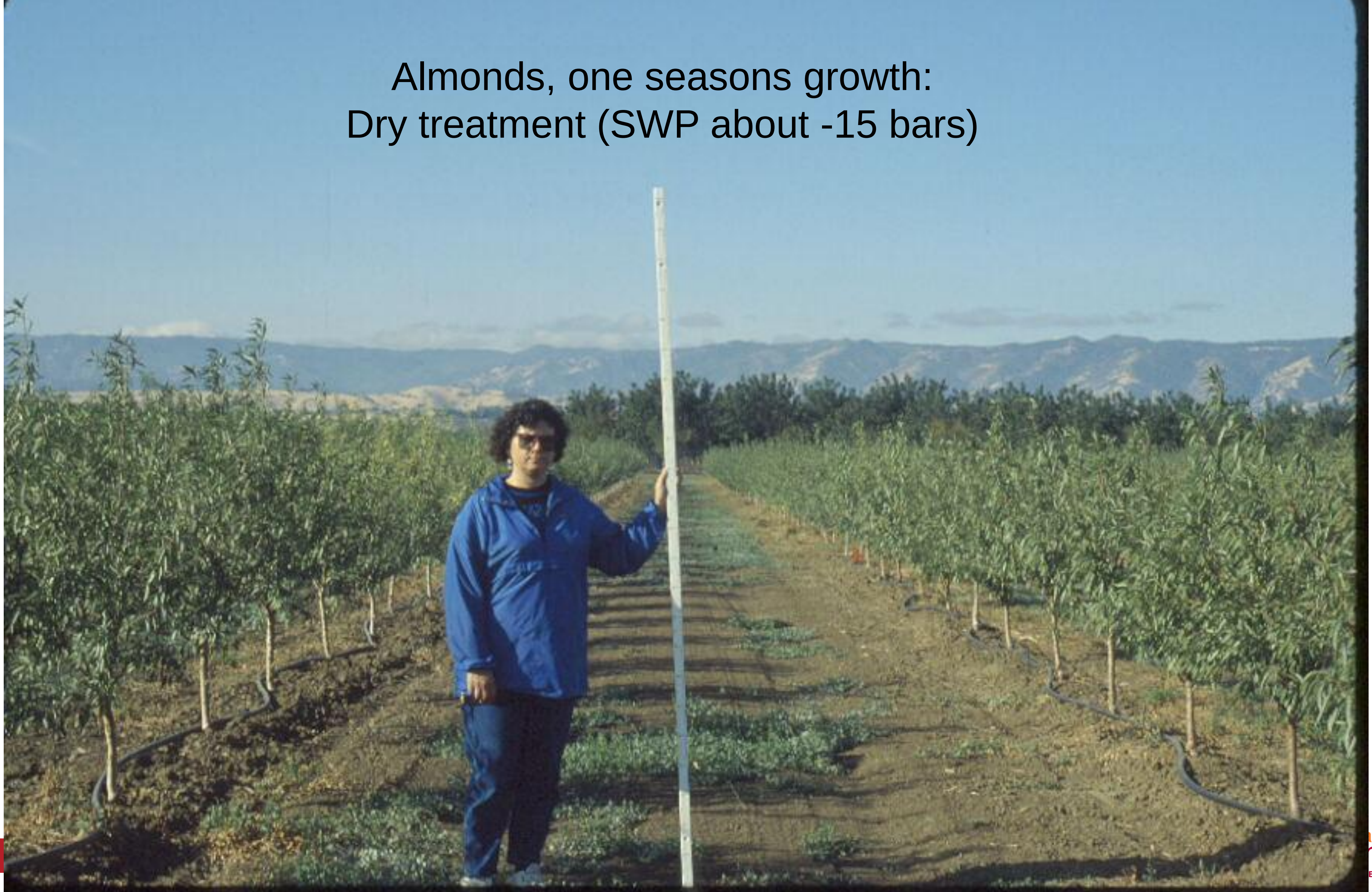


SWP levels and water stress symptoms in almond

SWP (bars): 0, -5, -10, -15, -20, -25, -30, -60

(No stress)	Very well hydrated tree condition, only observed in winter or early spring conditions.
(Minimal stress)	Indicates fully irrigated conditions, ideal for overall growth of young trees, and typical of mature trees from leaf-out through mid June.
(Mild stress)	Reduced overall growth of young trees and shoot extension in mature trees. Recommended stress (-14 to -18 bars) to advance and synchronize hull split, reduce hull rot, improve harvestability, and reduce shaking required for crop removal.
(Moderate stress)	Slow to no growth, interior leaf yellowing and drop, leaf flagging, leaf activity (e.g., stomatal opening, photosynthesis) reduced about 60%.
(Severe stress)	Substantial leaf drop, leaf activity reduced about 90%, subsequent year flowering and yield reduced 50% when associated with this SWP level in July, minimal canopy dieback.
(Extreme stress)	Complete defoliation, no flowering in the subsequent year, about 20% canopy dieback.

Almonds, one seasons growth:
Dry treatment (SWP about -15 bars)



Almonds, one seasons growth:
Medium treatment (SWP about -12 bars)

Almonds, one seasons growth:
Wet treatment (SWP about -8 bars)

Almond hull split

Proposed benefits of mild/moderate stress (-14 to -18 bars during hull split:

1) Speed up Hull Split
2) Reduce Hull rot
3) Reduce Sticktights (Improve Harvestability)
4) Save Water

2000 – 2003 study:

1) Corning location
2) Variable soil
3) Variable hull split: Split always sooner on gravel (west) soil.

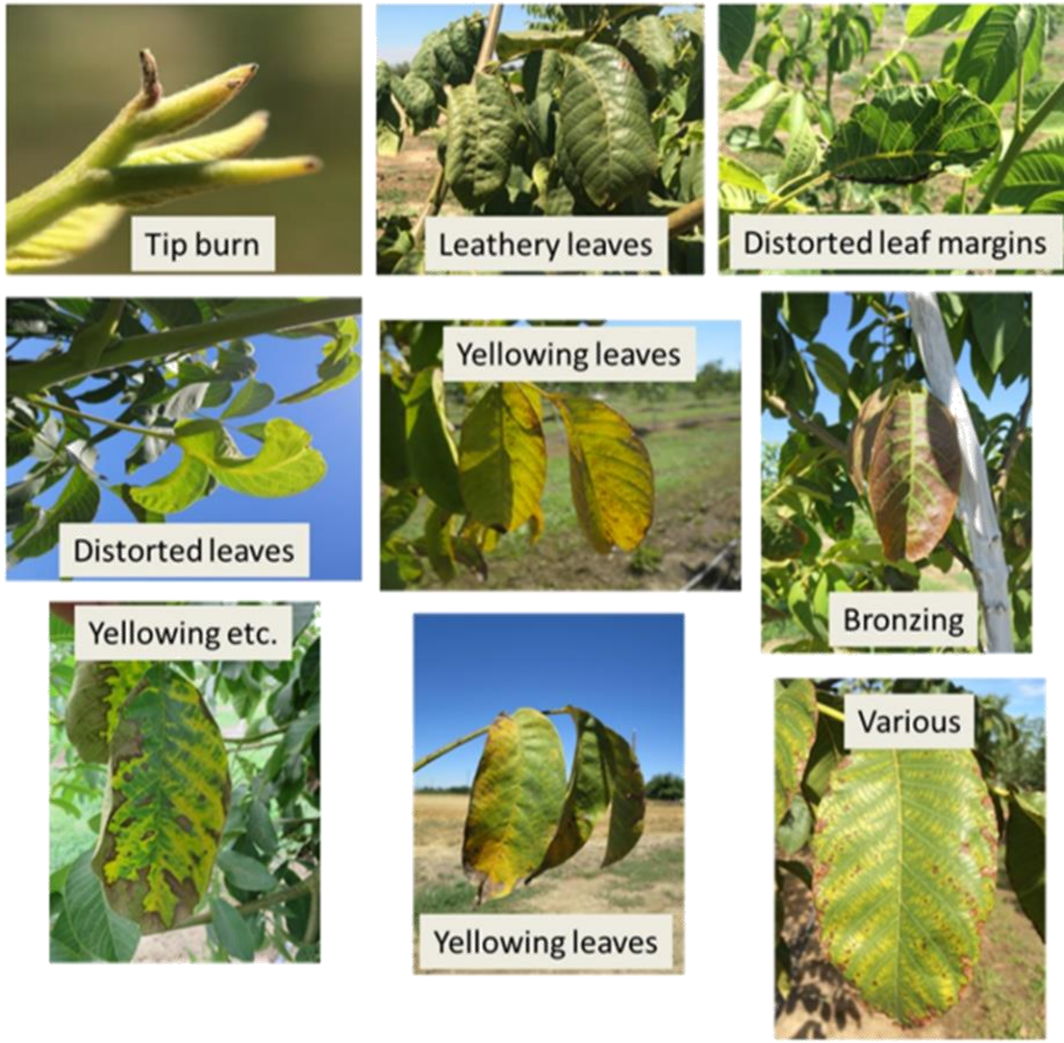
Problem was solved by irrigating based on SWP, not ET

Soil	2002		2003		2004	
	Water applied	Cutoff date	Water applied	Cutoff date	Water applied	Cutback date
East (silt)	24”	10-Jul	14”	1-Jul	18”	7-Jun
West (gravel)	40”	25-Aug	41”	4-Sep	36”	16-Sep
ETc	43”		40”		42”	

Substantially less water and a very long cutoff/cutback were OK on the East (silt) soil.

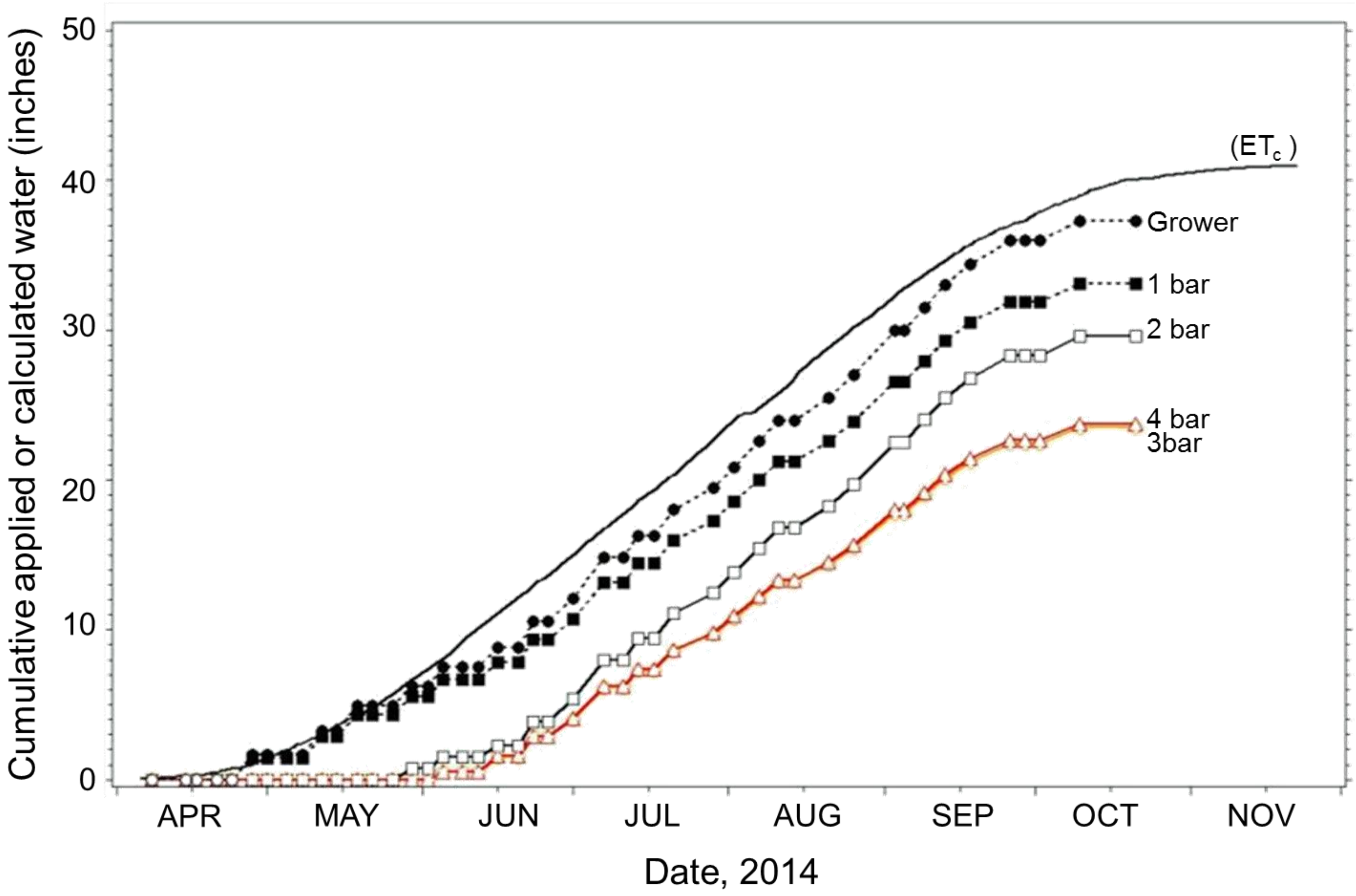
Current research in walnut: waiting for the trees to show at least mild stress before starting irrigation.

Observation (B. Lampinen): Trees that are consistently above baseline SWP in the spring can develop numerous symptoms later in the year, often mistaken for other disorders.



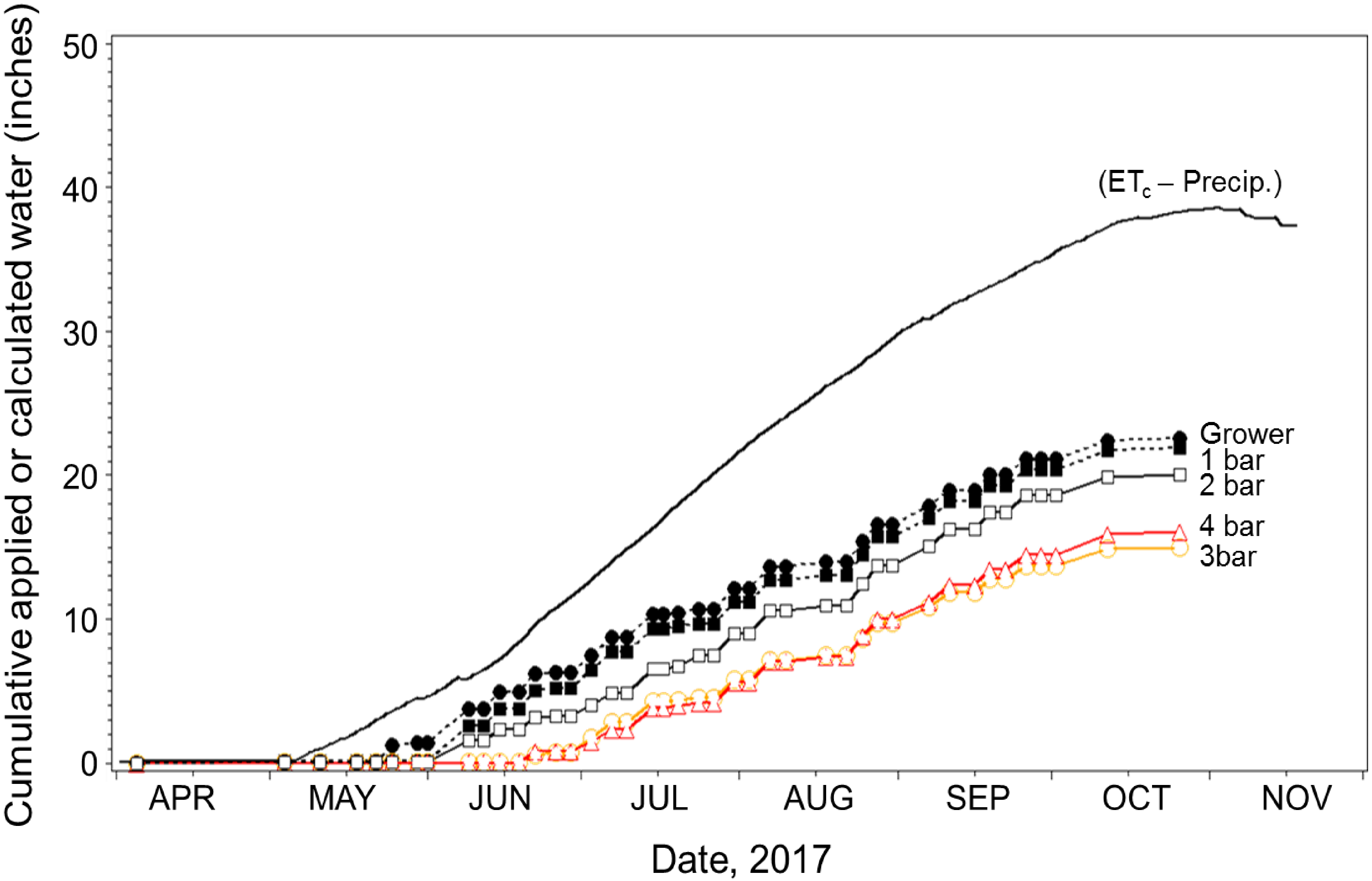
Year 1 (2014)

1) Grower closely matches ETc.
2) Waiting for 2 bar below baseline delays irrigation about 1 month.
3) No yield effect, but delayed trees ‘look better’ and are <u>less</u> stressed at harvest.

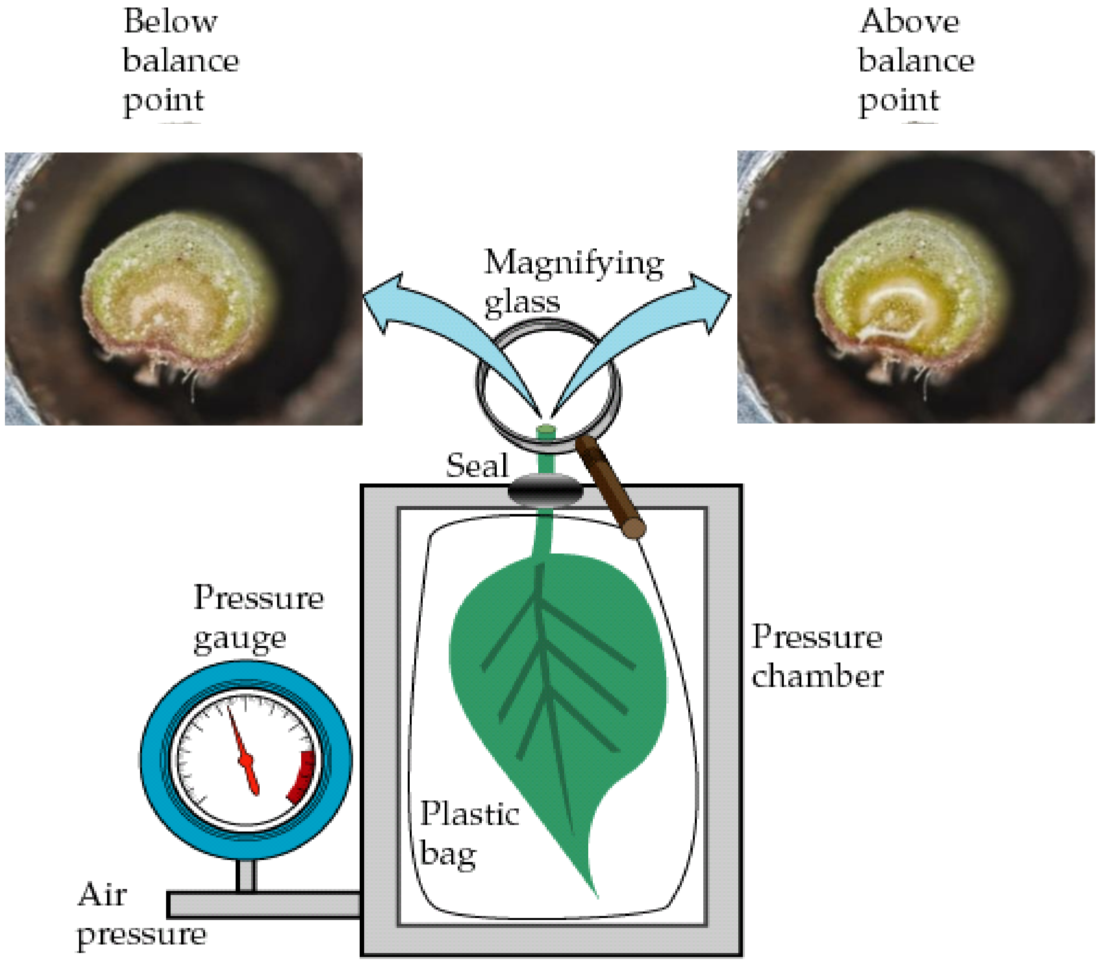


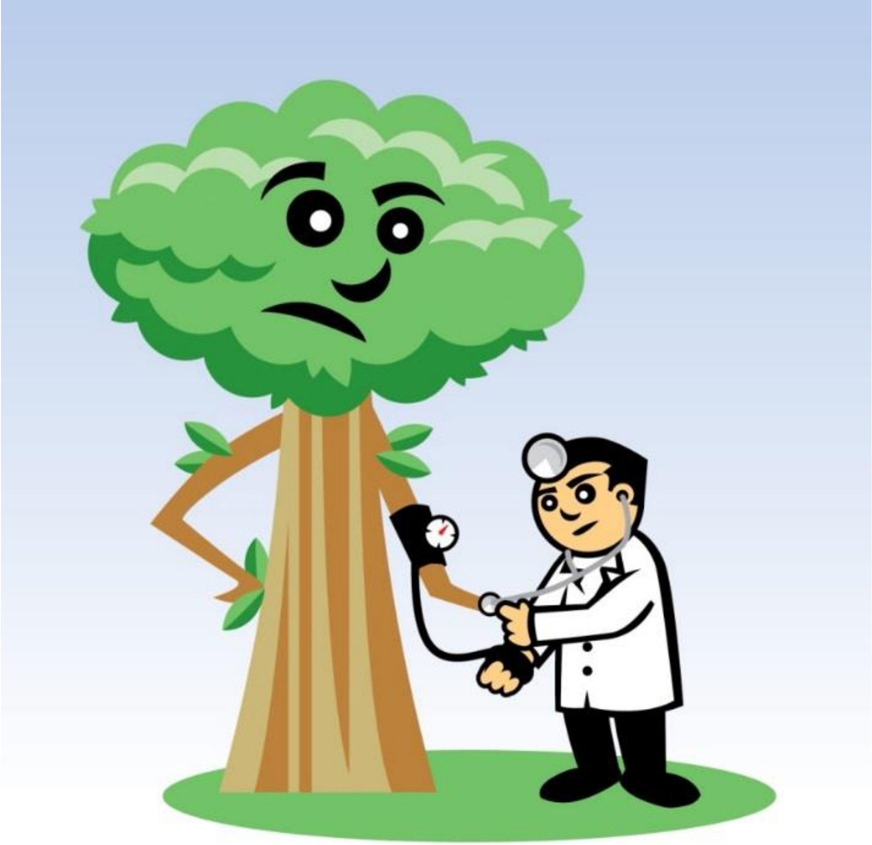
Year 4 (2017)

1) Grower not matching ETc.
2) Slightly smaller nuts for 3, 4 bar treatments, but no yield effect.
3) Some indication that delayed trees are using more soil moisture at depth.



Irrigation advice for more crop per drop?
Don't ask me, ask the tree.





Thanks for your support and attention!

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Resource-Efficient Irrigation:
Principles and Practical Implementation

The Almond Conference

December 5, 2018 – Sacramento, CA

Daniele Zaccaria, Ph.D.

Agricultural Water Management Specialist, UC Cooperative Extension

Ph.: (530) 219-7502   Email: dzaccaria@ucdavis.edu

PRESENTATION OBJECTIVES

1) Review the Principles of Irrigation Efficiency

2) Provide Information on Water & Energy Requirements

3) Discuss Main Design Parameters for Efficient Micro-Irrigation Systems

4) Describe Irrigation System Evaluation

Beneficial is the water used for crop production & health

- ✓Canopy Transpiration (T)
- ✓Chemical applications for pest & weeds control, fertilizers & nutrients
- ✓Frost Protection & Canopy Cooling
- ✓Leaching salts + soil amendments (gypsum, humic/fulvic acids and others)

$$Irr.Eff. = \frac{Water\ used\ by\ the\ crop\ for\ ET + Other\ Beneficial\ Uses}{Total\ water\ applied\ onto\ the\ field}$$

- ✓Replenish Soil Moisture Depleted since the last irrigation event (ETc)
- ✓Soil Evaporation + Deep Percolation + Surface Runoff + Wind Drift
- ✓Leakages from pipes, canal, ditches + valves/gates stuck-open, irrigation over-run, etc.
- ✓Water draining out of pipes and hoses after irrigation shut-off (pulsing on-off)
- ✓Pipe flushing + Screen cleaning & Filters back-flush
- ✓Pipe & hose chemical injection (keep the pipe system clean and functional)

Distribution Uniformity (D.U.) vs. Irrigation Efficiency (I.E.)

Distribution Uniformity:

is a number (%) describing how evenly water is distributed across the field/among plants

Irrigation Efficiency:

is the fraction of the total applied water that is beneficially used by the crop

EXAMPLE

2 gallons per tree in July

The trees will use every drop of this applied water

D.U. = 100%; I.E. = ~100%

200 gallons per tree in July

Trees will use only a fraction of the applied water

D.U. = 100%; I.E. << 100%

Irrigation Efficiency Components

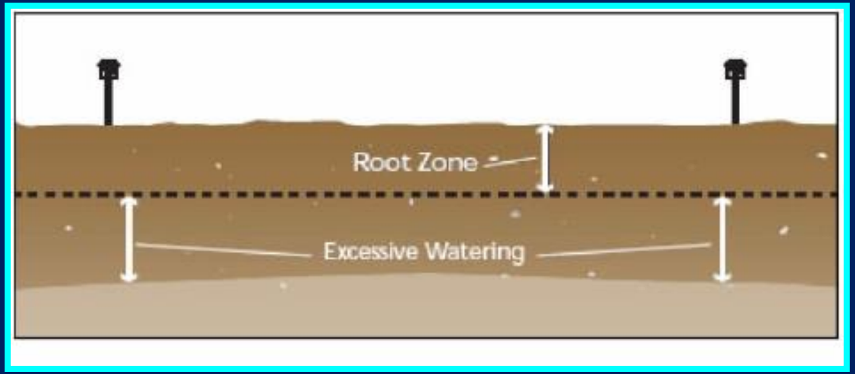
Irrigation Application

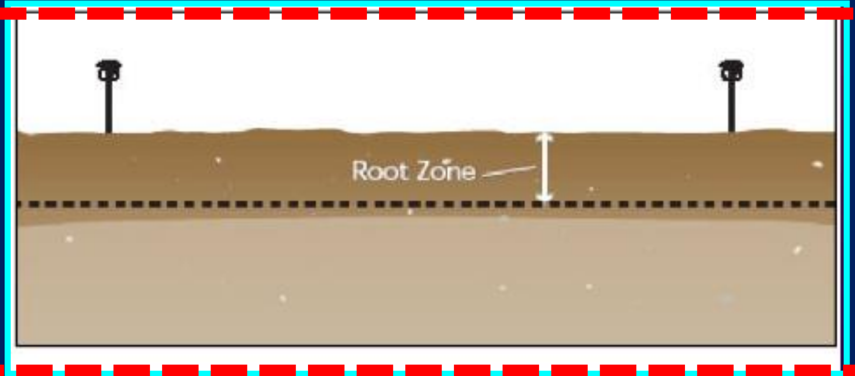
- ✓ **Adequacy of application**
  (depth or volume infiltrated & stored)
- ✓ **Application Uniformity (DU)**
  (similar water depth across field/plants)

Irrigation Losses

- ✓ **Soil Evaporation**
- ✓ **Deep percolation & Runoff**
- ✓ **Wind drift (sprinkler)**
- ✓ **Water draining out of pipes**

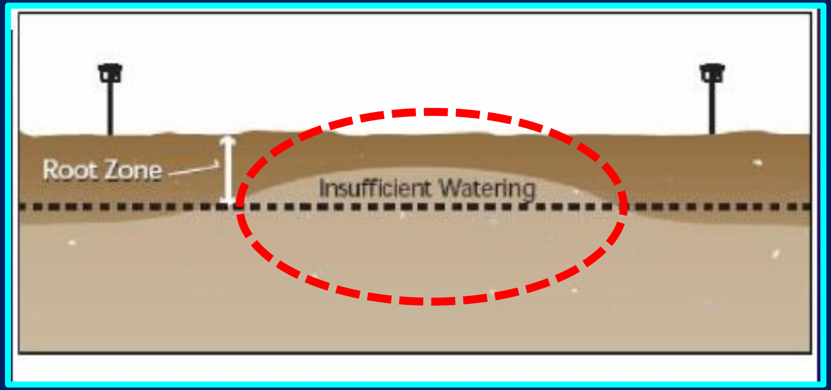
Adequacy of application refers to the depth or volume of water that infiltrates in the root zone and is available for plant use (T)

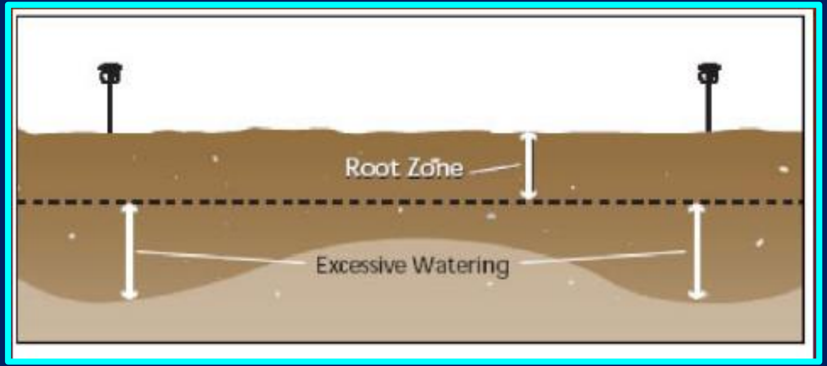




Whether an irrigation is adequate or not depends on the irrigation set-time & soil moisture status/depletion @ irrigation start

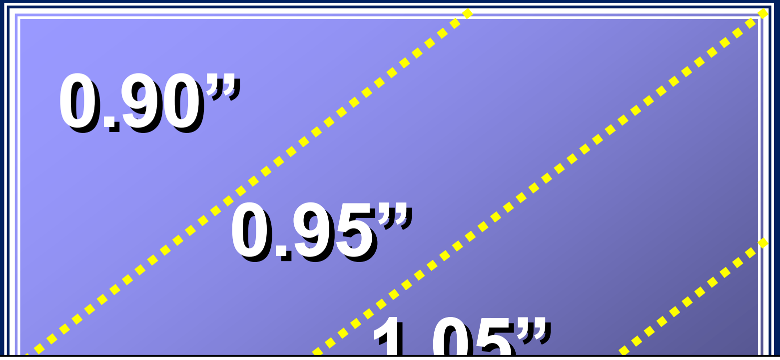
Whether water is distributed evenly among plants (D.U.) mainly depends on proper system design, operation & maintenance

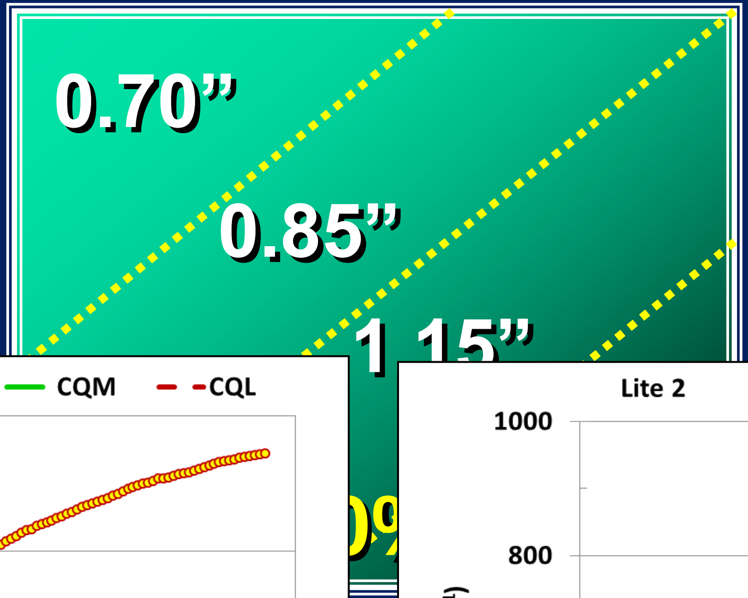


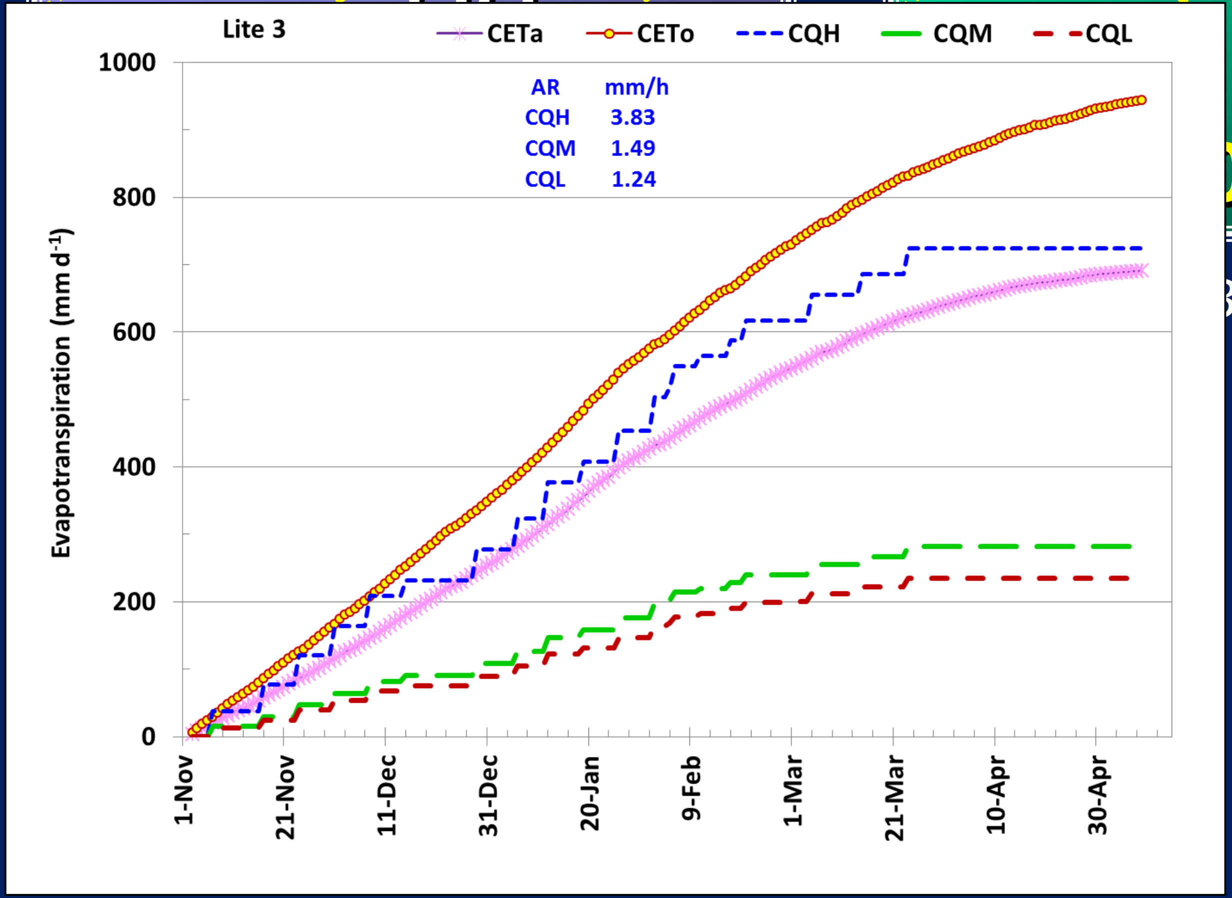


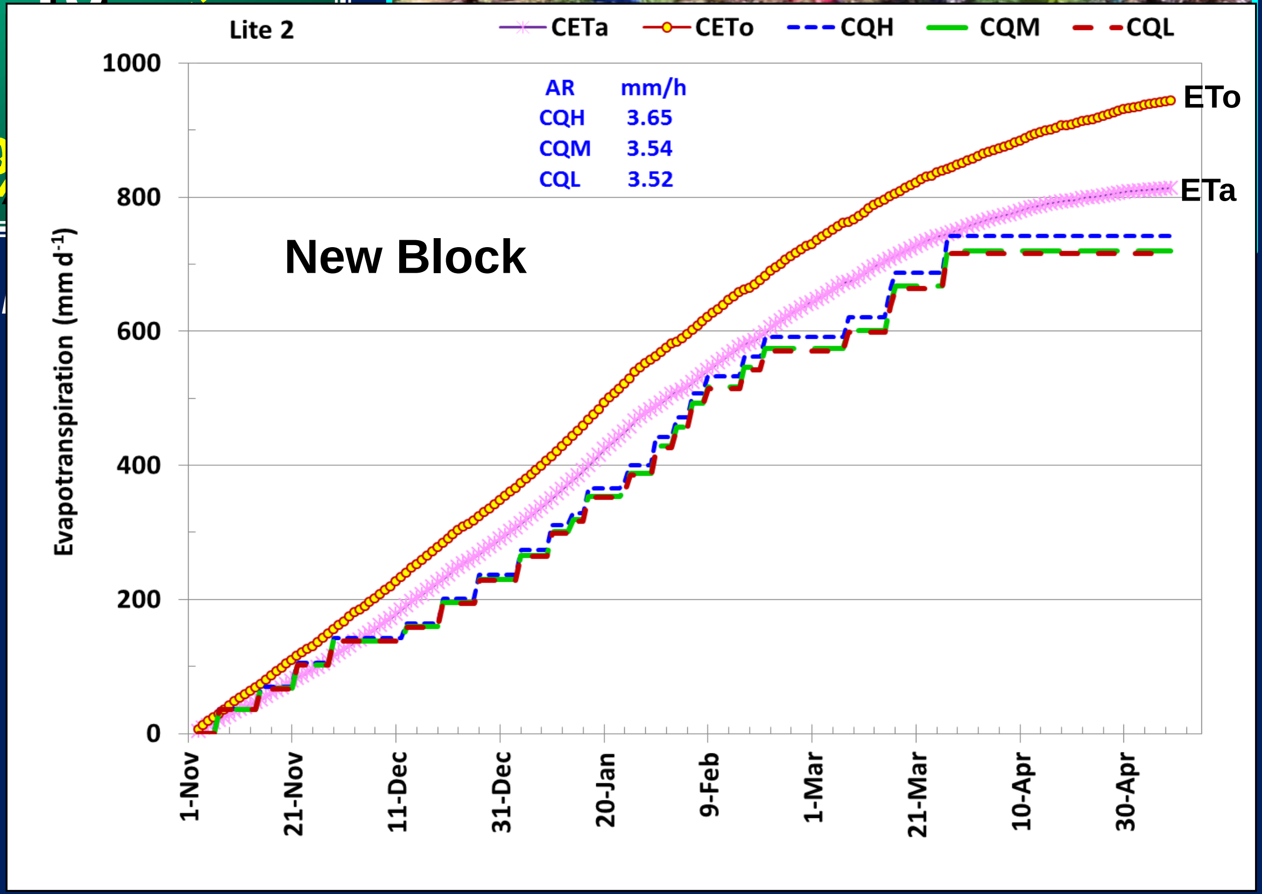
Some parts of the field must be over-irrigated so that the areas receiving less water can be adequately irrigated.

Target Application = 1.0 inch









WHAT IT TAKES TO BE EFFICIENT?

Good System Design

✓Accurate & Skilled
✓Flexible Operation

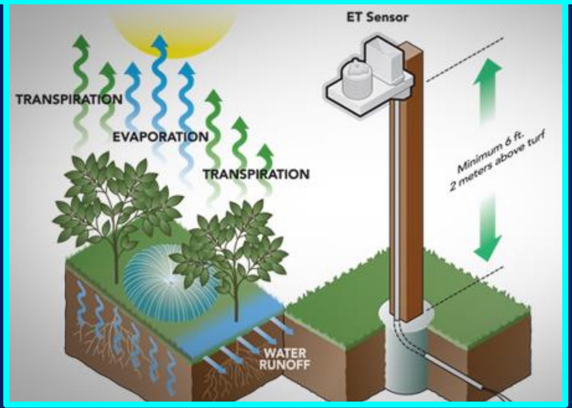
Proper Installation
Regular Maintenance
System Evaluation

Defined Irrigation Strategy

- Full Irrigation
- Deficit Irrigation (SDI, RDI)

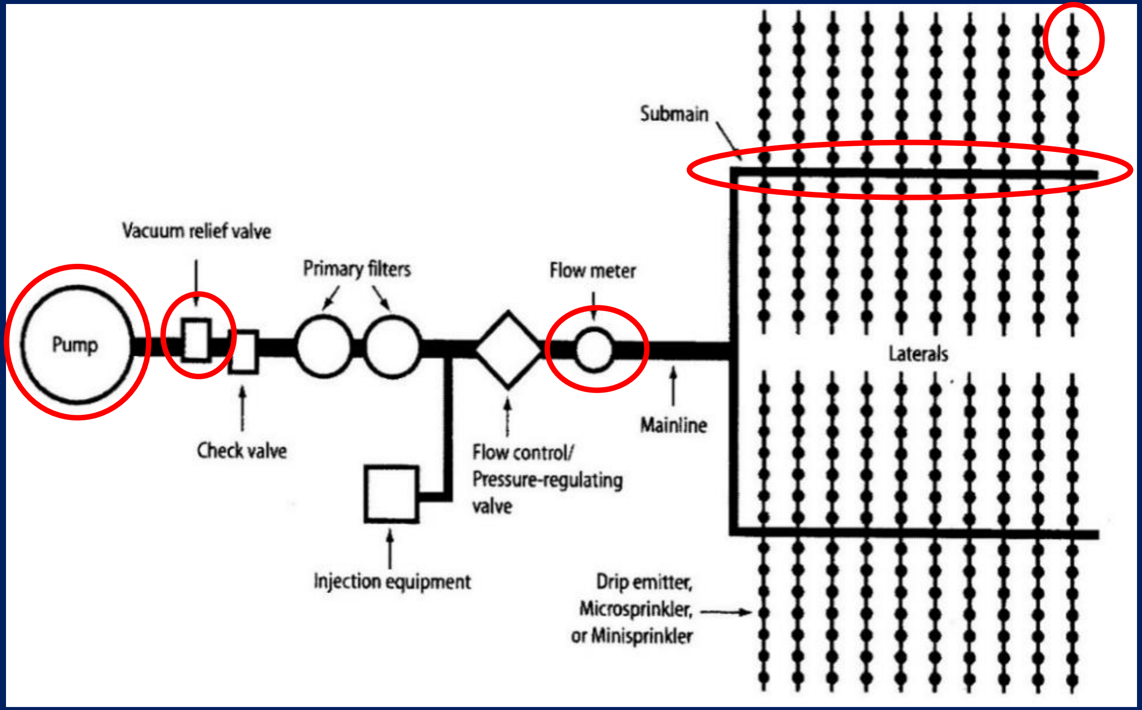
Accurate Irrigation Scheduling & Control

Implementation of Schedule & Feedback



DESIGN STAGE - Important aspects where to focus attention:

1) Conduct preliminary site testing/evaluations (soil type, slopes, water supply, plant spacing & density, canopy size, row orientation, etc.)
2) Define the **water application rate** based on soil properties (**infiltration rate**; **water holding capacity**, slope, etc.) and crop water needs (ET)
3) Size the different system's components from downstream to upstream
4) Ensure operational flexibility to the system



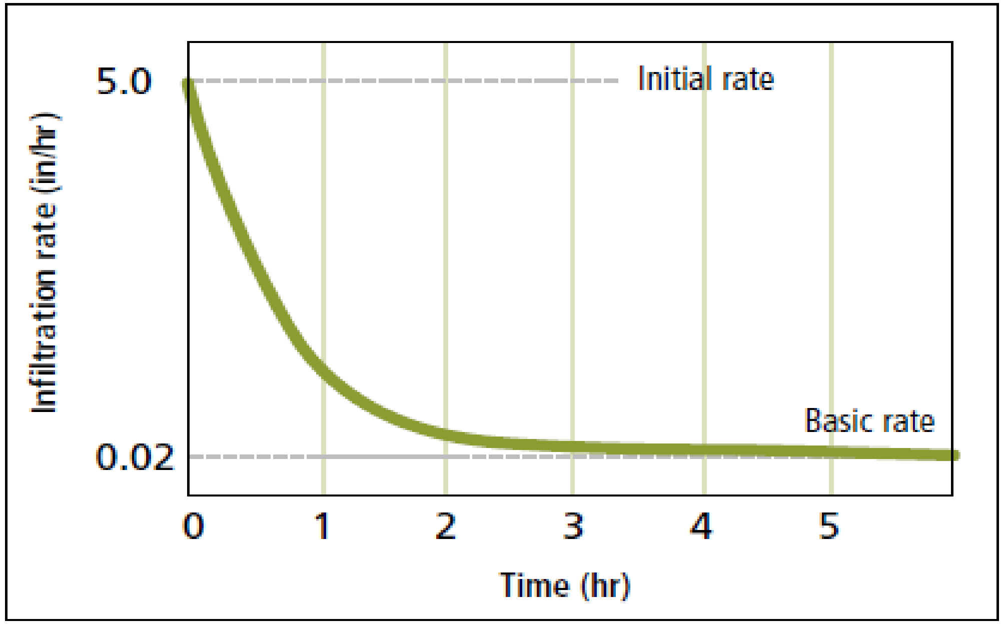
APPLICATION RATE << SOIL INTAKE RATE (in./hr)

System	Appl. Rate (in./hr)
Surface Irrigation	0.40 – 0.45
Sprinkler	0.12
Micro-sprinkler	0.01- 0.06
Drip	0.01 - 0.03

Table 1. Recommended maximum application rates for soils of various textures

Soil type	Maximum application rate (in/hr) at slope		
	0–5%	5–8%	8–12%
coarse sandy soil	1.5–2.0	1.0–1.5	0.75–1.0
light sandy soil	0.75–1.0	0.5–0.8	0.4–0.6
silt loam	0.3–0.5	0.25–0.4	0.15–0.3
clay loam, clay	0.15	0.10	0.08

Source: NRCS 1984.



SOIL TYPE	AVAILABLE WATER (IN./FT)	AVAILABLE WATER IN 4FT ROOT ZONE (IN.)
COARSE SAND	0.5	2.0
LOAMY SAND	1.0	4.0
SAND LOAM	1.5	6.0
FINE SANDY LOAM	2.0	8.0
CLAY LOAM	2.2	8.8
CLAY	2.3	9.2
ORGANIC CLAY LOAMS	4.0	16.0

http://anrcatalog.ucanr.edu/pdf.8515.pdf

Drought Management for California Almonds ANR Publication 8515

		Zone 12[4]		Zone 14[5]		Zone 15[6]		Zone 16[7]	
Month	K_c[3]	ET_o	ET_c	ET_o	ET_c	ET_o	ET_c	ET_o	ET_c
Jan	0.40	1.24	0.50	1.55	0.62	1.24	0.50	1.55	0.62
Feb	0.41	1.96	0.81	2.24	0.92	2.24	0.92	2.52	1.04
Mar	0.62	3.41	2.11	3.72	2.30	3.72	2.30	4.03	2.49
Apr	0.80	5.10	4.09	5.10	4.09	5.70	4.57	5.70	4.57
May	0.94	6.82	6.44	6.82	6.44	7.44	7.02	7.75	7.31
Jun	1.05	7.80	8.20	7.80	8.20	8.10	8.51	8.70	9.14
Jul	1.11	8.06	8.93	8.68	9.61	8.68	9.61	9.30	10.30
Aug	1.11	7.13	7.90	7.75	8.59	7.75	8.59	8.37	9.
Sep	1.06	5.40	5.73	5.70	6.05	5.70	6.05	6.30	6.
Oct	0.92	3.72	3.41	4.03	3.69	4.03	3.69	4.34	3.
Nov	0.69	1.80	1.23	2.10	1.44	2.10	1.44	2.40	1.
Dec	0.43	0.93	0.40	1.55	0.66	1.24	0.53	1.55	0.
Total (in)			49.73		52.61		53.73		57.

Monthly Average Reference Evapotranspiration by ETo Zone (inches/month)

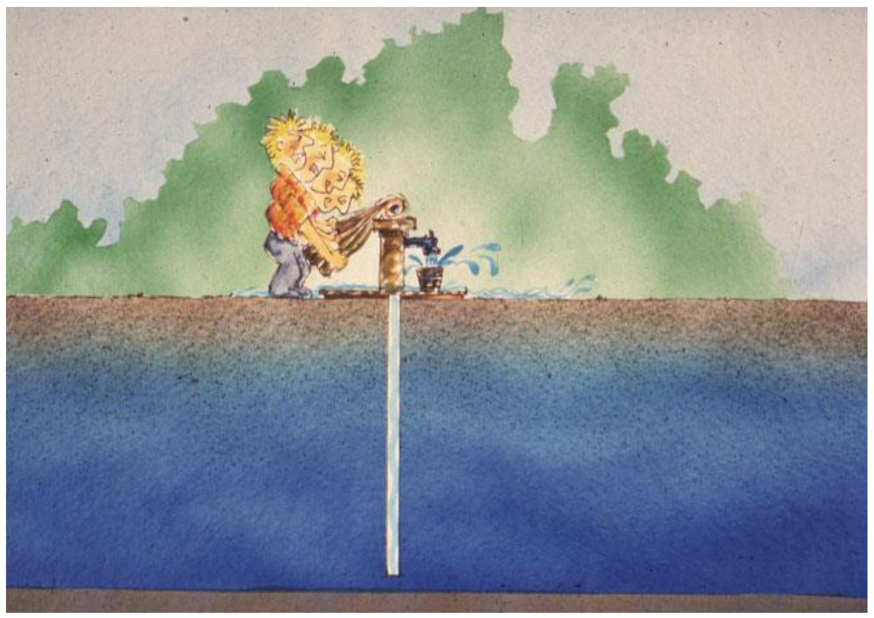
Zone	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1	0.93	1.40	2.48	3.30	4.03	4.50	4.65	4.03	3.30	2.48	1.20	0.62	33.0
2	1.24	1.68	3.10	3.90	4.65	5.10	4.96	4.65	3.90	2.79	1.80	1.24	39.0
3	1.86	2.24	3.72	4.80	5.27	5.70	5.58	5.27	4.20	3.41	2.40	1.86	46.3
4	1.86	2.24	3.41	4.50	5.27	5.70	5.89	5.58	4.50	3.41	2.40	1.86	46.6
5	0.93	1.68	2.79	4.20	5.58	6.30	6.51	5.89	4.50	3.10	1.50	0.93	43.9
6	1.86	2.24	3.41	4.80	5.58	6.30	6.51	6.20	4.80	3.72	2.40	1.86	49.7
7	0.62	1.40	2.48	3.90	5.27	6.30	7.44	6.51	4.80	2.79	1.20	0.62	43.4
8	1.24	1.68	3.41	4.80	6.20	6.90	7.44	6.51	5.10	3.41	1.80	0.93	49.4
9	2.17	2.80	4.03	5.10	5.89	6.60	7.44	6.82	5.70	4.03	2.70	1.86	55.1
10	0.93	1.68	3.10	4.50	5.89	7.20	8.06	7.13	5.10	3.10	1.50	0.93	49.1
11	1.55	2.24	3.10	4.50	5.89	7.20	8.06	7.44	5.70	3.72	2.10	1.55	53.0
12	1.24	1.96	3.41	5.10	6.82	7.80	8.06	7.13	5.40	3.72	1.80	0.93	53.3

ENERGY REQUIREMENTS FOR IRRIGATION

It takes 1.37 whp-hr/ac-ft per foot of lift

(power the pump must provide to lift 1 ac-foot of water by 1 foot)

FUEL SOURCE	PUMP OUTPUT
ELECTRICITY	0.885 whp-hr/kWh
NATURAL GAS (925 BTU)	61.7 whp-hr/MCF
NATURAL GAS (1000 BTU)	66.7 whp-hr/MCF
DIESEL	12.50 whp-hr/gal
PROPANE	6.89 whp-hr/gal



Source of Energy	Energy Units to Lift Water
Electricity	1.55 kWh/ac-ft per foot of lift
Natural Gas (925 BTU)	0.22 MCF/ac-ft per foot of lift
Natural Gas (1000 BTU)	0.20 MCF/ac-ft per foot of lift
Diesel	0.10 Gal/ac-ft per foot of lift
Propane	0.20 Gal/ac-ft per foot of lift

Source: Nebraska Pumping Plant Performance Criteria (NPPPC)

Mature Almond with Micro-Sprinkler vs. Drip Irrigation

Almond ET = 50 in. => 4.2 ft of water per season (SJV)

Area = 80 acres

Irrigation methods: Micro-Sprinkler (40 psi) Vs. Drip Irrig. (25 psi) @ pump outp.

Water Lift = 100 ft (from aquifer level to ground)

$TDH_{MICRO\text{-}SPR.}$: 100 ft + (40 psi x 2.31 ft/psi) = **192 ft**

TDH_{DI}: 100 ft + (25 psi x 2.31 ft/psi) = **158 ft**

Total ac-ft $_{MICRO\text{-}SPR.}$ = 4.2/0.85 = **4.9 ac-ft**

Total ac-ft $_{DI}$ = 4.2/0.90 = **4.6 ac-ft**

Diesel => **0.10 gal/ac-ft** per foot of lift

Ave. Price of Diesel for Ag.= **$3.50** per gallon

System	Eff.$_A$
Surface Irrig.	**0.75**
Sprinkler	**0.80**
Micro-sprinkler	**0.85**
Drip & SDI	**0.90**

Vol. Micro-Sprinkler: 80 ac x 4.9 ac-ft x 192 ft x 0.10 gal/ac-ft = **7,526 gal**

Cost for Micro-Sprinkler irrigation: 7,526 gal x $3.50 per gallon = **$26,341**

Vol. Drip Irrigation = 80 ac x 4.6 ac-ft x 158 ft x 0.10 gal/ac-ft = **5,814 gal**

Cost for Drip Irrigation: 5,814 gal x $3.50 per gallon = **$20,350**

COMBINATIONS OF DIFFERENT IRRIGATION SCHEDULING APPROACHES

Plant-based
(Monitoring plant water status) → **Proper Irrigation Timing**

↓

Weather-based
(Estimating the crop water use) → **Adequate Irrigation Amount**

↓

Soil-based
(Monitoring soil moisture) → **Check for Feedback**

IRRIGATION SYSTEM EVALUATION

- ✓ How much water my system applies per hour (application rate)?
- ✓ How long to run the system to refill the water used by the crop?
- ✓ What is the distribution uniformity (DU) of my system?
- ✓ What are the main problems to be corrected?

WHAT PARAMETERS ARE MEASURED IN THE FIELD?

FLOWRATE

PRESSURE






Collection time:	0.5	minutes
Hose pressure at emitters:	24.5	psi
	Collected volume:	
#1	258	mL
#2	304	mL
#3	290	mL
#4	320	mL
#5	288	mL
#6	305	mL
#7	312	mL
#8	220	mL
#9	310	mL
#10	320	mL
#11	315	mL
#12	307	mL
#13	305	mL
#14	312	mL
#15	297	mL
#16	304	mL

The average flow rate was	9.0287	gph.
The average application rate was	0.0362	in/hr.
The Flow DU for this location was	91.0248	%

Collection time:	0.5	minutes
Hose pressure at emitters:	19.5	psi
	Collected volume:	
#1	300	mL
#2	305	mL
#3	317	mL
#4	220	mL
#5	285	mL
#6	282	mL
#7	284	mL
#8	283	mL
#9	245	mL
#10	294	mL
#11	180	mL
#12	282	mL
#13	295	mL
#14	300	mL
#15	290	mL
#16	287	mL
#17	284	mL
#18	291	mL
#19	292	mL
#20	295	mL
#21	286	mL
#22	283	mL
#23	263	mL
#24	255	mL
#25	289	mL
#26	294	mL
#27	291	mL
#28	298	mL

The average flow rate was	8.9101	gph.
The average application rate was	0.0357	in/hr.
The Flow DU for this location was	87.7764	%

SOME RECOMMENDATIONS

Have a professional system evaluation at least every 2-3 years
DU and App. Rate tend to change over time

Know your system application rate & DU
$\Rightarrow$ Key elements for irrigation scheduling and efficiency

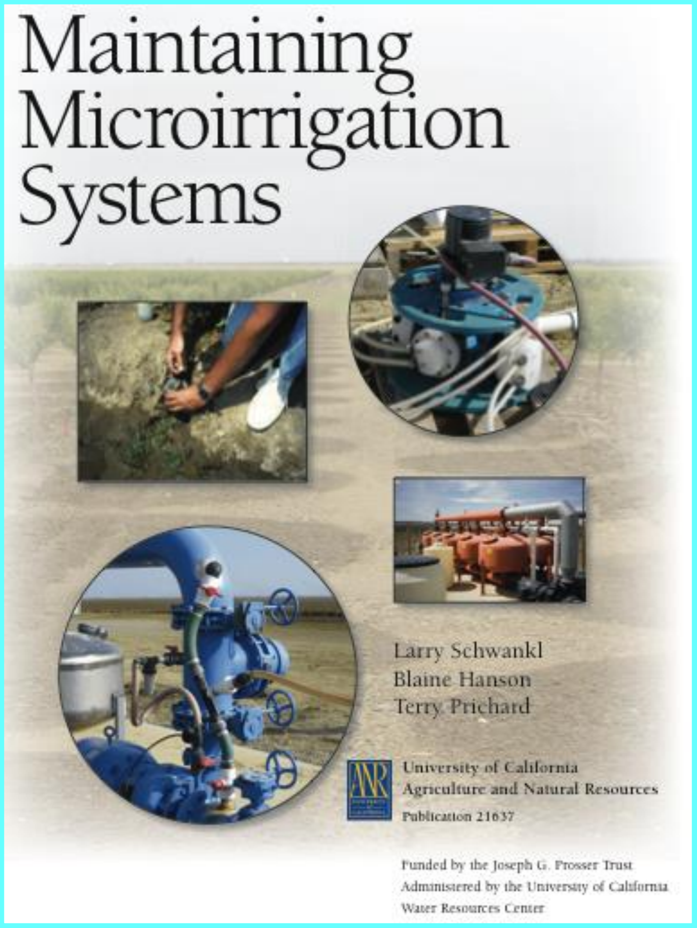
(Time to run the system = water to be applied/application rate)

Monitor the system periodically to spot and correct problems

(Check flowrate and pressure at critical points)

HIGH EFFICIENCY REQUIRES SIGNIFICANT EFFORTS IN ROUTINE MAINTENANCE

- ✓ Checking for leaks (farm equipment & animals)
- ✓ Back-flushing filters (manually or automatically)
- ✓ Periodically flushing main, submain and laterals (in that order)
- ✓ Chlorinating for organic material: continuous (1-2 ppm) or periodic (10-50 ppm)
- ✓ Acidifying (lowering Ph. < 7-5) to avoid/remove precipitates
- ✓ Cleaning or replacing clogged emitters and other components



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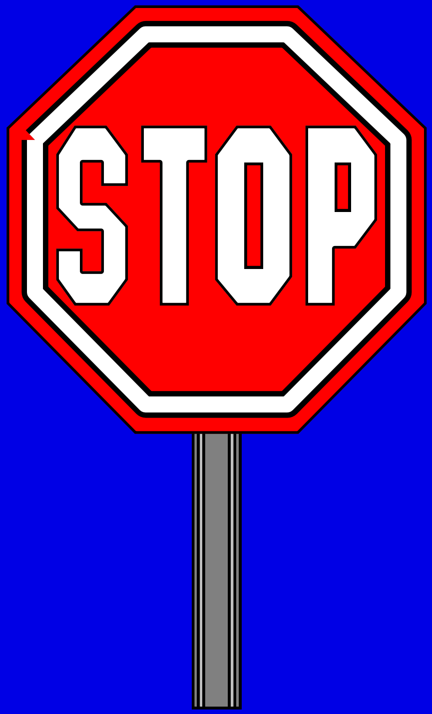


THANK YOU !!

QUESTIONS OR COMMENTS?

Why caring about being efficient irrigators?

✓REDUCE WATER AND ENERGY BILLS FOR PRODUCING OUR CROPS (sprinkler & micro-irrigation, groundwater pumping)

✓GROW MORE ACREAGE WITH SAME WATER/ENERGY OR OBTAIN HIGHER YIELD

✓HEALTHY CROP => LESS WATER-RELATED PROBLEMS (water stress, hypoxia, asphyxia, phytophtora, weeds growth, etc.)

✓BETTER CONTROL ON WATER & NUTRIENTS IN THE SOIL FOR PLANTS

✓COMPLIANCE WITH ENVIRONMENTAL REGULATIONS (ILRP, SGMA, AB 589, BILL32, AB 1886)

INEFFICIENT IRRIGATION OFTEN LEADS TO:

- ✓ Higher costs (labor, water, nutrients, pumping)
- ✓ Crop yield lower than max potential (or alternate bearing)
- ✓ Uneven/slow plants development & production
- ✓ Leaching nutrients, fertilizers and pesticides

AMOUNT OF IRRIGATION WATER TO APPLY

$$A_{pp.}W_{ater} = (ET_a - R_{eff})/AE_{AVE}$$

System	AE_{AVE}
Gravity (Surface Irr)	70-85%
Drip	85-90%
Micro-sprinkler	80-90%
Sprinkler	70-90%

R_{eff} = [Rainfall – 0.25 in.) x 0.8

Max ET_{Daily} = 0.35 in => Max $AW_{2\text{-}day}$ = 0.7 in/0.85 = 0.8 in (< 24 hr)

Micro-irrigation systems are typically designed to deliver the peak water amounts in 20/24 hrs

$$T_{IRR} = \frac{D_{G\ MAX}}{Appl.\ Rate} = \frac{D_{G\ MAX}}{< Soil\ Intake\ Rate}$$

System	Appl. Rate (in./hr)
Surface Irr.	0.40 – 0.45
Sprinkler	0.12
Micro-sprinkler	0.05
Drip	0.01 - 0.03

If soil intake rate and water holding capacity allow, application rate can be increased to reduce irrigation set time and benefit from tiered energy rates or DR

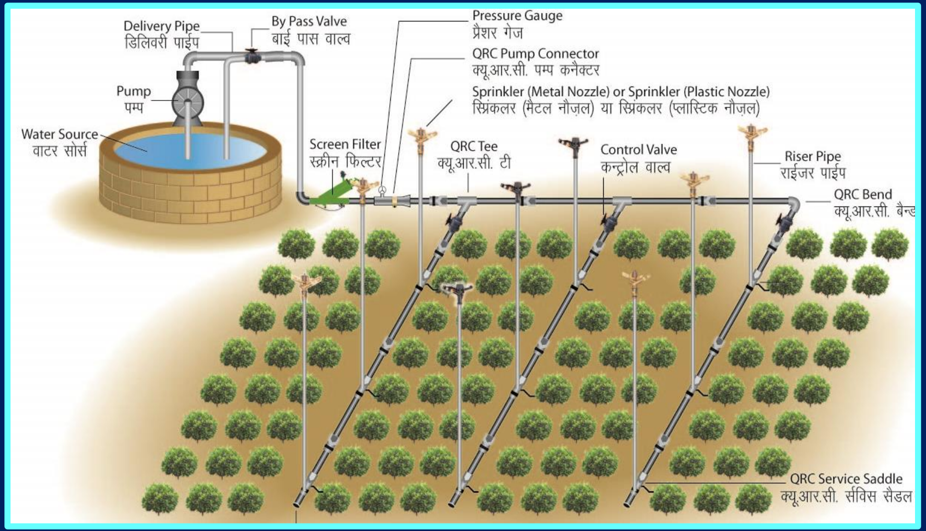
DIFFERENCES BETWEEN IRRIGATION METHODS

SURFACE IRRIGATION METHODS

Infiltrated water mainly depends on soil intake rate, flowrate, slope and length of fields (water travels onto the ground across the field)

SPRINKLER & MICRO-IRRIGATION

Infiltrated water mainly depends on system’s characteristics
(water travels along the pipe system and is discharged in the vicinity of plants)



Cost: $40-60 per acre

What are the main factors affecting system D.U.?

- **Pressure difference between emitters** (friction losses, elevation differences, etc.) cause flow differences

- **Uneven spacing:** non-uniformity caused by having a different number of emitters per unit area or per plant in the field

- **Unequal drainage**: after system shut-off some emitters may continue to drain for some time while most of emitters have stopped discharging water (sloping blocks, pulsing irrigation on/off)

- **Other causes**: emitter clogging, wear (gypsum), manufacturing variations (variation in size of orifices and flowrates due to the manufacturing process)

CLOGGING IS THE MAIN CAUSE OF POOR SYSTEM D.U.

Main causes of clogging include:

- ✓ Suspended material in the irrigation water
- ✓ Chemical precipitation in emitters
- ✓ Biological growths in emitters
- ✓ Root intrusion
- ✓ Soil ingestion

Thank you!

California Almonds
Almond Board of California

growing ADVANTAGE
The Almond Conference

What's Next

Wednesday, December 5 at 12:00 p.m.

- Luncheon Presentation – Hall C
  Speaker: David Deak

Luncheon is ticketed and is sponsored by Moss Adams

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Silent Auction

Start your holiday shopping at our Silent Auction in Hall A+B - all proceeds go towards CA FFA scholarships!

Wednesday & Thursday until 3:00 p.m.

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100 GOLDEN TICKETS WILL BE SOLD

★ ★ ★ ★ GOLDEN TICKET ★ ★ ★ ★

Throughout the conference 100 golden tickets will be sold. One lucky person will win and get their choice of one item from the live auction.

MUST BE PRESENT AT THE GALA DINNER TO WIN.

Visit the FFA silent auction booth to purchase a golden ticket and learn more!

The golden ticket winner will be drawn prior to the live auction.