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

• **Podcast:** Growing the Valley

GrowingTheValleyPodcast.com
Subscribe: Apple iTunes and Google Play Music

• **Website:** SacValleyOrchards.com
“Water is life!”
– Ken Shackel (UC Davis)
Yield: Beyond Water
Yield $= \text{kernel number} \times \text{weight per kernel}$
Yield = \text{kernel number} \times \text{weight per kernel}

\text{kernel number} = \text{Number of flowers and flowering spurs} \times \%

\text{Number of flowers that become aln} \text{ (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)
Plant and Mange for the ‘80/20 Rule’

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

Nickels Soil Lab. Arbuckle, CA
Franz Niederholzer, UCCE Colusa and Sutter/Yuba
Avoid:

– Nutrient deficiencies
– Severe pest and disease infestations
## Nitrogen Fertilizer: within a year of changes, yield differences can appear

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>125 lb</td>
<td>3,500&lt;sup&gt;a&lt;/sup&gt;</td>
<td>2,700&lt;sup&gt;a&lt;/sup&gt;</td>
<td>2,800&lt;sup&gt;a&lt;/sup&gt;</td>
<td>3,800&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>200 lb</td>
<td>3,500&lt;sup&gt;a&lt;/sup&gt;</td>
<td>2,900&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>3,400&lt;sup&gt;b&lt;/sup&gt;</td>
<td>4,300&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>275 lb</td>
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<td>3,200&lt;sup&gt;b&lt;/sup&gt;</td>
<td>3,700&lt;sup&gt;bc&lt;/sup&gt;</td>
<td>4,600&lt;sup&gt;c&lt;/sup&gt;</td>
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<tr>
<td>350 lb</td>
<td>3,700&lt;sup&gt;a&lt;/sup&gt;</td>
<td>3,500&lt;sup&gt;b&lt;/sup&gt;</td>
<td>4,000&lt;sup&gt;c&lt;/sup&gt;</td>
<td>4,700&lt;sup&gt;c&lt;/sup&gt;</td>
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</table>

*Rounded to nearest hundred lbs*
Potassium Fertilizer: can increase yield, especially following a heavy crop year

<table>
<thead>
<tr>
<th>Treatment (K₂O/acre/year)</th>
<th>1998 Kernel yield (lb/acre)</th>
<th>1999 Kernel yield (lb/acre)</th>
<th>2000 Kernel yield (lb/acre)</th>
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<tbody>
<tr>
<td>0 lb</td>
<td>800 a</td>
<td>4000 a</td>
<td>2400 a</td>
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<tr>
<td>240 lb</td>
<td>900 a</td>
<td>3800 a</td>
<td>2900 b</td>
</tr>
<tr>
<td>600 lb</td>
<td>800 a</td>
<td>4400 a</td>
<td>2900 b</td>
</tr>
<tr>
<td>960 lb</td>
<td>1000 a</td>
<td>4000 a</td>
<td>2800 b</td>
</tr>
</tbody>
</table>

*Rounded to nearest hundred lbs

Reidel, Weinbaum, Brown and Duncan, UC Davis

Potassium deficiency linked to increased % spur death
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

<table>
<thead>
<tr>
<th>(Yield) lbs/Ac</th>
<th>% NOW (grade sheet)</th>
<th>% NOW (left in field)</th>
<th>Total % NOW damage</th>
<th>Good meats (lbs/ac)</th>
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</thead>
<tbody>
<tr>
<td>2,500</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>2,500</td>
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<tr>
<td>2,500</td>
<td>1%</td>
<td>1%</td>
<td>2%</td>
<td>2,450</td>
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<td>2%</td>
<td>2%</td>
<td>4%</td>
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<td>3%</td>
<td>6%</td>
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<tr>
<td>2,500</td>
<td>10%</td>
<td>10%</td>
<td>20%</td>
<td>2,000</td>
</tr>
</tbody>
</table>

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!

GrowingTheValleyPodcast.com
Subscribe: Apple iTunes and Google Play Music

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
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

<table>
<thead>
<tr>
<th>Year</th>
<th>Average Nonpareil Kernel Yield, #/ac</th>
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<tr>
<td>2017</td>
<td>770</td>
</tr>
<tr>
<td>2018</td>
<td>1450</td>
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</table>

(Predicted relation)
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?
Brian Bailey’s lidar map & ET model

Lysimeter tree

Wood colony tree

Kearney Almonds - Oct. 11, 2017

- lysimeter
  - model (non-pareil)
  - model (pareil)

Evaporation rate (kg/day)

Time (PST)
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).
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.
More detail at the poster!

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

<table>
<thead>
<tr>
<th>SWP (bars)</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>0</td>
<td>(No stress) Very well hydrated tree condition, only observed in winter or early spring conditions.</td>
</tr>
<tr>
<td>-5</td>
<td>(Minimal stress) Indicates fully irrigated conditions, ideal for overall growth of young trees, and typical of mature trees from leaf-out through mid June.</td>
</tr>
<tr>
<td>-10</td>
<td>(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.</td>
</tr>
<tr>
<td>-15</td>
<td>(Moderate stress) Slow to no growth, interior leaf yellowing and drop, leaf flagging, leaf activity (e.g., stomatal opening, photosynthesis) reduced about 60%.</td>
</tr>
<tr>
<td>-20</td>
<td>(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.</td>
</tr>
<tr>
<td>-25</td>
<td></td>
</tr>
<tr>
<td>-30</td>
<td>(Extreme stress) Complete defoliation, no flowering in the subsequent year, about 20% canopy dieback.</td>
</tr>
<tr>
<td>-60</td>
<td></td>
</tr>
</tbody>
</table>
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

<table>
<thead>
<tr>
<th>Soil</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
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<tbody>
<tr>
<td></td>
<td>Water</td>
<td>Cutoff</td>
<td>Water</td>
</tr>
<tr>
<td></td>
<td>applied</td>
<td>date</td>
<td>applied</td>
</tr>
<tr>
<td>East</td>
<td>24”</td>
<td>10-Jul</td>
<td>14”</td>
</tr>
<tr>
<td>(silt)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>West</td>
<td>40”</td>
<td>25-Aug</td>
<td>41”</td>
</tr>
<tr>
<td>(gravel)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ETc</td>
<td>43”</td>
<td></td>
<td>40”</td>
</tr>
</tbody>
</table>

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 less 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!
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
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)

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

- 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

DU = 90%

0.90”

0.95”

1.05”

DU = 70%

0.70”

0.85”

1.15”

Source: Blake Sanden, UC CE Kern County, Bakersfield, CA
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)

<table>
<thead>
<tr>
<th>System</th>
<th>Appl. Rate (in./hr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surface Irrigation</td>
<td>0.40 – 0.45</td>
</tr>
<tr>
<td>Sprinkler</td>
<td>0.12</td>
</tr>
<tr>
<td>Micro-sprinkler</td>
<td>0.01 – 0.06</td>
</tr>
<tr>
<td>Drip</td>
<td>0.01 - 0.03</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Soil type</th>
<th>Maximum application rate (in/hr) at slope</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0–5%</td>
</tr>
<tr>
<td>coarse sandy soil</td>
<td>1.5–2.0</td>
</tr>
<tr>
<td>light sandy soil</td>
<td>0.75–1.0</td>
</tr>
<tr>
<td>silt loam</td>
<td>0.3–0.5</td>
</tr>
<tr>
<td>clay loam, clay</td>
<td>0.15</td>
</tr>
</tbody>
</table>


![Graph showing infiltration rate reduction over time](image)

<table>
<thead>
<tr>
<th>SOIL TYPE</th>
<th>AVAILABLE WATER (IN./FT)</th>
<th>AVAILABLE WATER IN 4FT ROOT ZONE (IN.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>COARSE SAND</td>
<td>0.5</td>
<td>2.0</td>
</tr>
<tr>
<td>LOAMY SAND</td>
<td>1.0</td>
<td>4.0</td>
</tr>
<tr>
<td>SAND LOAM</td>
<td>1.5</td>
<td>6.0</td>
</tr>
<tr>
<td>FINE SANDY LOAM</td>
<td>2.0</td>
<td>8.0</td>
</tr>
<tr>
<td>CLAY LOAM</td>
<td>2.2</td>
<td>8.8</td>
</tr>
<tr>
<td>CLAY</td>
<td>2.3</td>
<td>9.2</td>
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<tr>
<td>ORGANIC CLAY LOAMS</td>
<td>4.0</td>
<td>16.0</td>
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</table>
### Drought Management for California Almonds

**ANR Publication 8515**


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

<table>
<thead>
<tr>
<th>Zone</th>
<th>Jan</th>
<th>Feb</th>
<th>Mar</th>
<th>Apr</th>
<th>May</th>
<th>Jun</th>
<th>Jul</th>
<th>Aug</th>
<th>Sep</th>
<th>Oct</th>
<th>Nov</th>
<th>Dec</th>
<th>Total</th>
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<tr>
<td>1</td>
<td>0.93</td>
<td>1.40</td>
<td>2.48</td>
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<td>4.03</td>
<td>4.50</td>
<td>4.65</td>
<td>4.83</td>
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<td>8.06</td>
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<td>1.96</td>
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</table>
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)

<table>
<thead>
<tr>
<th>FUEL SOURCE</th>
<th>PUMP OUTPUT</th>
</tr>
</thead>
<tbody>
<tr>
<td>ELECTRICITY</td>
<td>0.885 whp-hr/kWh</td>
</tr>
<tr>
<td>NATURAL GAS (925 BTU)</td>
<td>61.7 whp-hr/MCF</td>
</tr>
<tr>
<td>NATURAL GAS (1000 BTU)</td>
<td>66.7 whp-hr/MCF</td>
</tr>
<tr>
<td>DIESEL</td>
<td>12.50 whp-hr/gal</td>
</tr>
<tr>
<td>PROPANE</td>
<td>6.89 whp-hr/gal</td>
</tr>
</tbody>
</table>

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)

\[
\begin{align*}
\text{TDH}_{\text{MICRO-SPR.}} &: 100 \text{ ft} + (40 \text{ psi} \times 2.31 \text{ ft/psi}) = 192 \text{ ft} \\
\text{TDH}_{\text{DI}} &: 100 \text{ ft} + (25 \text{ psi} \times 2.31 \text{ ft/psi}) = 158 \text{ ft} \\
\end{align*}
\]

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

<table>
<thead>
<tr>
<th>System</th>
<th>Eff._A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surface Irrig.</td>
<td>0.75</td>
</tr>
<tr>
<td>Sprinkler</td>
<td>0.80</td>
</tr>
<tr>
<td>Micro-sprinkler</td>
<td>0.85</td>
</tr>
<tr>
<td>Drip &amp; SDI</td>
<td>0.90</td>
</tr>
</tbody>
</table>

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
<table>
<thead>
<tr>
<th>Collection time:</th>
<th>0.5 minutes</th>
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<tbody>
<tr>
<td>Hose pressure at emitters:</td>
<td>24.5 psi</td>
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</tbody>
</table>

**Collected volume:**

<table>
<thead>
<tr>
<th>#1</th>
<th>mL</th>
</tr>
</thead>
<tbody>
<tr>
<td>#2</td>
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<td>#3</td>
<td>mL</td>
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<td>#4</td>
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<td>#6</td>
<td>mL</td>
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<td>#14</td>
<td>mL</td>
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<tr>
<td>#15</td>
<td>mL</td>
</tr>
<tr>
<td>#16</td>
<td>mL</td>
</tr>
</tbody>
</table>

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 %

<table>
<thead>
<tr>
<th>Collection time:</th>
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<tbody>
<tr>
<td>Hose pressure at emitters:</td>
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</table>

**Collected volume:**

<table>
<thead>
<tr>
<th>#1</th>
<th>mL</th>
</tr>
</thead>
<tbody>
<tr>
<td>#2</td>
<td>mL</td>
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<td>#3</td>
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<tr>
<td>#16</td>
<td>mL</td>
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</tbody>
</table>

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 ⇒ 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

Publication available at:
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

\[
A_{pp, Water} = \frac{(ET_a - R_{eff})}{AE_{AVE}}
\]

\[
R_{eff} = \text{[Rainfall} - 0.25 \text{ in.]} \times 0.8
\]

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

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

\[
T_{IRR} = \frac{D_{G,MAX}}{\text{Appl. Rate}} = \frac{D_{G,MAX}}{< \text{Soil Intake Rate}}
\]

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!
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
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.
Buy Your Golden Ticket at the FFA Booth

100 Golden Tickets Will Be Sold

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.