Efficient Irrigation Water Management

Larry Schwankl
Irrigation Specialist, UC Cooperative Extension
559-646-6569  ljschwankl@ucanr.edu

Presentation will be available at:  http://ucanr.edu/schwankl
Irrigation Efficiency

- What portion of the applied irrigation water is used by the crop?

\[
\text{Irrigation Efficiency} = \frac{\text{Water beneficially used}}{\text{Water applied}} \times 100
\]

- Doesn’t tell you where on the field the water was applied.
SURFACE RUNOFF

PERCOLATION
Why should we care about being efficient?

- Cost of both surface water and groundwater.
Why should we care about being efficient?

- Cost for both surface water and groundwater.
- Limited water availability.
Why should we care about being efficient?

- Cost for both surface water and groundwater.
- Limited water availability.
- Inefficient water use closely tied to nitrate leaching.
What does it take to be efficient?

- Putting on the right amount of water at the right time.
What does it take to be efficient?

- Putting on the right amount of water at the right time.

Irrigation Scheduling

+ Good knowledge & Operation of the Irrigation System
How can you do this?

- **Step 1:**
  - Use evapotranspiration (ET) scheduling to plan ahead about how much to irrigate.
    - Plan ahead using historical ET averages and then compare the averages to real-time ET to see if you need to “correct” for actual weather conditions.
How can you do this?

- **Step 1:**
  - Use evapotranspiration (ET) scheduling to plan ahead about how much to irrigate.
  - **Sources of ET info:**
    - Google: CIMIS

CIMIS website has info. on historical and real-time reference ETo

Crop ET = ETo x crop coefficient
How can you do this?

- **Step 1:**
  - Use evapotranspiration (ET) scheduling to plan ahead about how much to irrigate.

- **Sources:**
  - Google: CIMIS
  - UC Publication:

Historical ET

How can you do this?

- **Step 1:**
  - Use evapotranspiration (ET) scheduling to plan ahead about how much to irrigate.

- **Sources:**
  - Google: CIMIS
  - UC Publication:
  - Allan Fulton ET service – real-time ET.
How can you do this?

- **Step 1:**
  - Use evapotranspiration (ET) scheduling to plan ahead about how much to irrigate.

- **Step 2:**
  - Apply the correct amount of water to match ET.
How can you do this?

- **Step 1:**
  - Use evapotranspiration (ET) scheduling to plan ahead about how much to irrigate.

- **Step 2:**
  - Apply the correct amount of water to match ET.
    - Know the irrigation system application rate.
    - Irrigation application uniformity.
Application Rate:

- We provide tree water use (ET) information in units of “inches of water use per day (or inches per week........)”
Application Rate:

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- Need to know the system application rate in order to know how long to run the system.
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- Need to know the system application rate in order to know how long to run the system.

- Easiest way to get application rate info. is to work with your local Mobile Lab.
Sprinkler Application Rate

Available as a free download at:
**Sprinkler Application Rate**

- Sprinkler application rates usually given in units of “inches per hour”.
- Works great with crop water use (ET) info. which is given in “inches per day” or “inches per week”.

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*Image: Sprinkler system being operated and a field with precision irrigation tools.*
Microirrigation Irrigation Scheduling

- Crop water use (ET) info. provided in units of “in/day”.
- Microsprinkler and drip system applications measured in units of “gal/hour” (gph).
Microirrigation Irrigation Scheduling

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<table>
<thead>
<tr>
<th>Water use</th>
<th>Tree</th>
<th>Tree water</th>
</tr>
</thead>
<tbody>
<tr>
<td>(gal/day)</td>
<td>(ft²)</td>
<td>(in/day)</td>
</tr>
<tr>
<td>by the tree</td>
<td>spacing x use x 0.623</td>
<td></td>
</tr>
</tbody>
</table>

We can convert ET info. given in **inches/day** to ET info. in **gal/day**
Microirrigation Application Rate

- Microsprinkler and drip system applications measured in units of “gal/hour” (gph).

Easiest, and best, way to get application rate info. is to use the **Mobile Lab**

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**Non-pressure-compensating Micro**

**Pressure-compensating (PC) Micro**
Managing Your Microirrigation System
Microirrigation Application Rate

- Use mobile lab
- Use flow meter
- Head of system
Microirrigation Application Rate

- Use mobile lab
- Use flow meter
- Head of system
- On laterals

Flowmeters on Lateral Lines

Your system may have small totalizing flowmeters installed on individual lateral lines throughout the system. While not very common in California, these flowmeters do have advantages. They normally cost less than $100 apiece and provide good information about emission uniformity. On the other hand, they may be less convenient to install and maintain than a single flowmeter at the head of the system.

To determine the application rate on the lateral line, record the meter reading and time at the beginning and end of your irrigation set. Then follow the three steps below to find your application rate in inches per hour:

Step 1: Divide acre-inches by the number of hours, to determine application rate in acre-inches per hour.

If meter readings are in gallons or acre-feet, use one of the conversion formulas on the previous page.

Step 2: Determine irrigated area of the lateral line in acres, using the following formula.

\[
\text{irrigated area (acres)} = \frac{\text{lateral length (feet)} \times \text{lateral spacing (feet)}}{43,560}
\]

Step 3: Divide applied water (Step 1) by irrigated area (Step 2) to find application rate.

\[
\text{application rate (in/hr)} = \frac{\text{applied water (ac-in/hr)}}{\text{irrigated area (acres)}}
\]
Efficient Irrigation Management

- We have to factor in some additional irrigation to account for irrigation inefficiencies.
Efficient Irrigation Management

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  - We usually measure the uniformity of the irrigation system and use that to estimate the irrigation efficiency.
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  - We usually measure the **uniformity** of the irrigation system and use that to estimate the irrigation efficiency.

Again, the easiest, and best, way to get the irrigation uniformity is to have the **mobile lab** do it for you.
Efficient Irrigation Management

- We have determined (estimated) the:
  - ET
  - Application rate
  - Irrigation efficiency
Efficient Irrigation Management

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  - ET
  - Application rate
  - Irrigation efficiency

- We need a check on whether we are doing OK.
Efficient Irrigation Management

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  - ET
  - Application rate
  - Irrigation efficiency

- We need a check on whether we are doing OK.

  - Good checks:
    - Soil moisture monitoring.
    - Plant-based monitoring.
Soil Moisture Monitoring

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Soil Moisture Monitoring

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  – Monitoring soil moisture and assuming what is happening with soil moisture is reflected in the crop.
  – Not a bad assumption as long as the soil moisture monitoring is accurately reflecting what the crop is experiencing.
  – If we are doing a good job with our ET estimates and managing the irrigations correctly, the soil moisture readings should reflect that.
Soil Moisture Monitoring

Watermark Soil Moisture Blocks 2007
Westside Site 2  No Stress/ 180# N

Soil Moisture - centibars

Date

30-Apr  20-May  9-Jun  29-Jun  19-Jul  8-Aug  28-Aug  17-Sep  7-Oct
Soil Moisture Monitoring

• What are we doing with soil moisture monitoring?
  – Not a bad assumption as long as the soil moisture monitoring is accurately reflecting what the tree is experiencing.
  
  • Biggest limitation of all soil moisture monitoring is locating instruments at sites which are representative.

Even a bigger challenge when using drippers and microsprinklers since soil moisture can change significantly in just a short distance.
Efficient Irrigation Management

- **Plant-based Monitoring:**
  - We actually monitor the plant to determine how well watered it is.
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Great tool for monitoring the plant's water status but

Very labor intensive
Efficient Irrigation Management

- Record keeping!!!!
  - ET records.
  - Irrigation application records.
  - Soil moisture and/or pressure bomb records.
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- Hints for handling all the data:
  - Don’t get behind!
  - Figure out a method by which field staff can get data to decision makers.
  - Have systems which “log” the data whenever you can.
  - Get the info. into graphics form whenever possible.
Questions?

Larry Schwankl
559-646-6569  e-mail: ljschwankl@ucanr.edu

For Powerpoint presentation go to:
http://ucanr.edu/schwankl