Efficient Irrigation Water Management

Larry Schwankl

Irrigation Specialist, UC Cooperative Extension

559-646-6569 ljschwankl@ucanr.edu

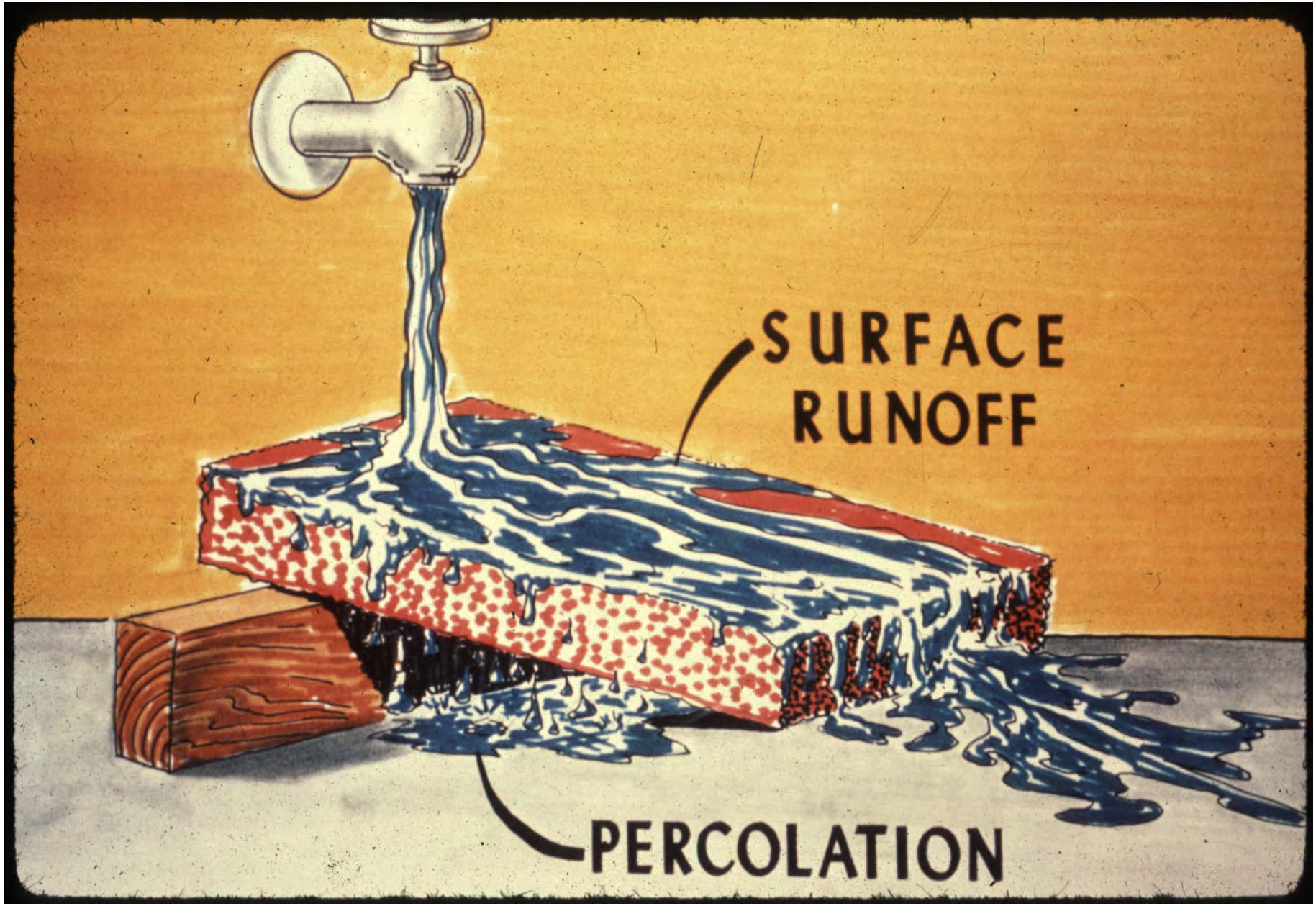
Presentation will be available at: http://ucanr.edu/schwankl

Irrigation Efficiency

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

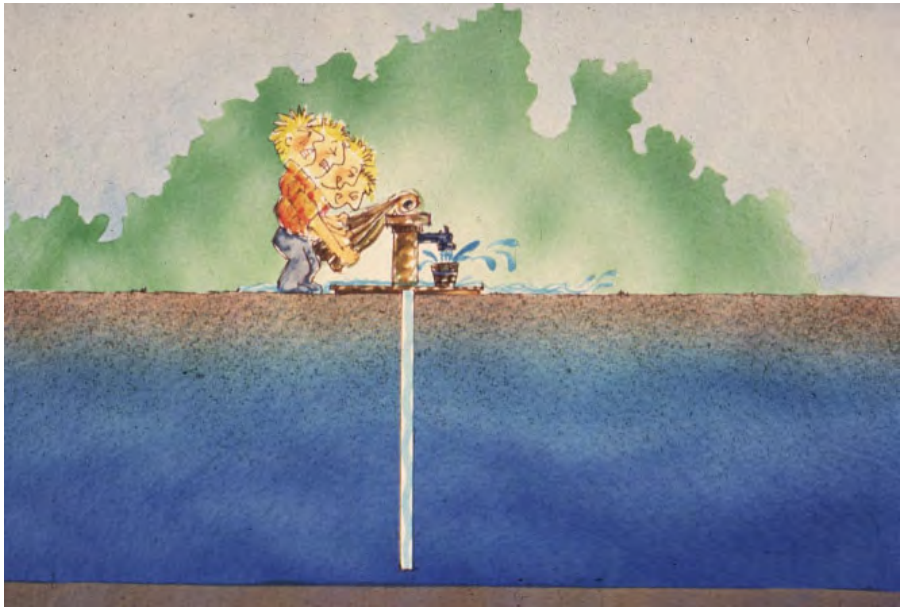
$$\text{Irrigation Efficiency (IE - \%)} = \frac{\text{Water beneficially used}}{\text{Water applied}} \times 100$$

- 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.**

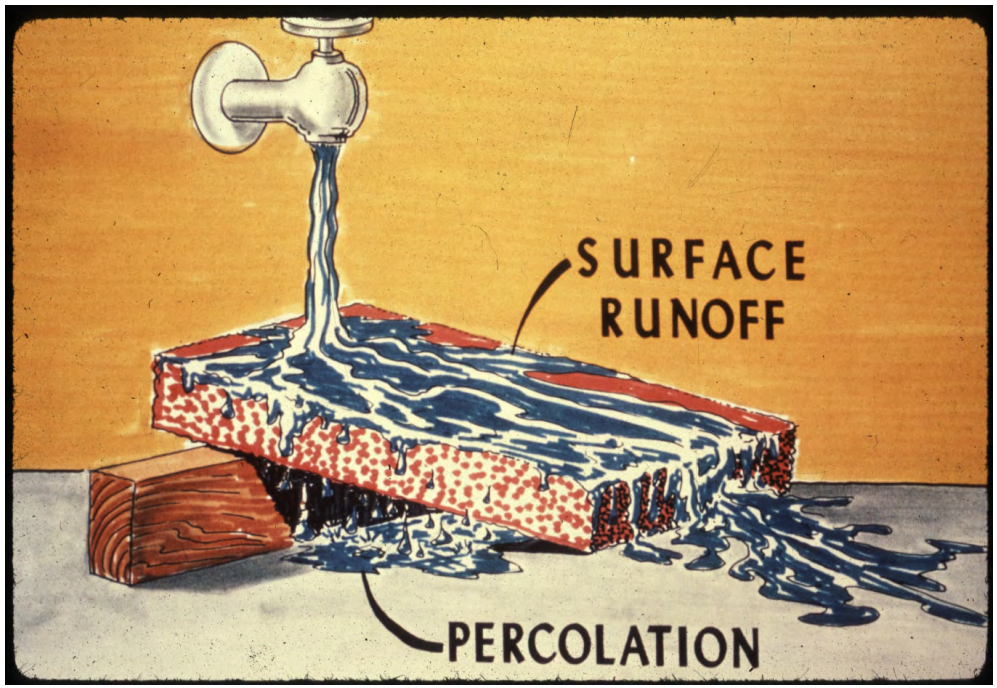


Why should we care about being efficient?

- 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.**

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- 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?

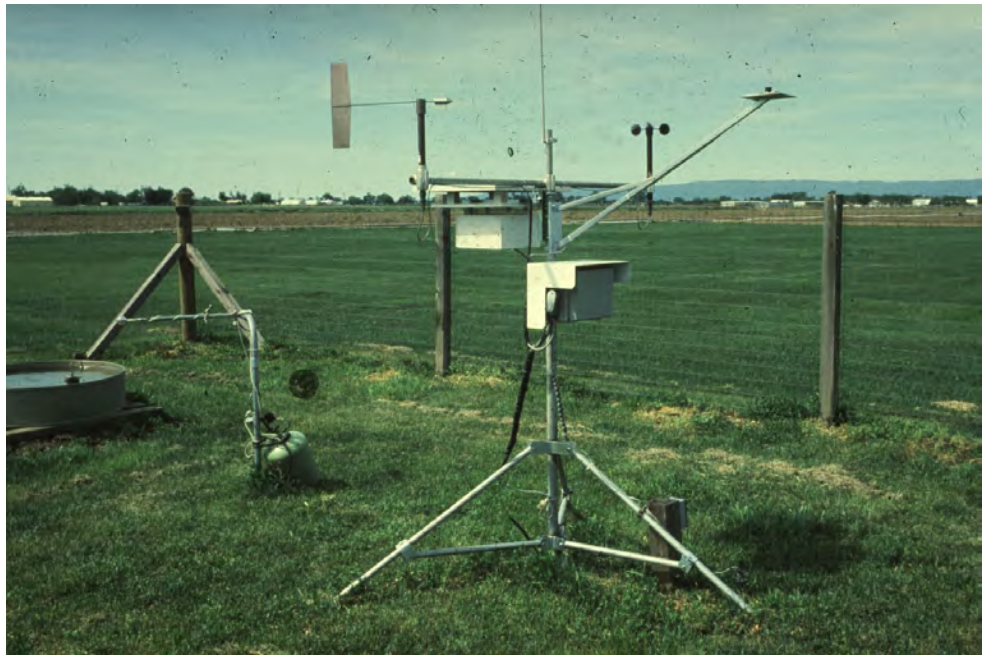
- **Step 1:**
  - **Use evapotranspiration (ET) scheduling to plan ahead about how much to irrigate.**
    - **Plan ahead using historical ET averages and then compare the averages to real-time ET to see if you need to "correct" for actual weather conditions.**

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

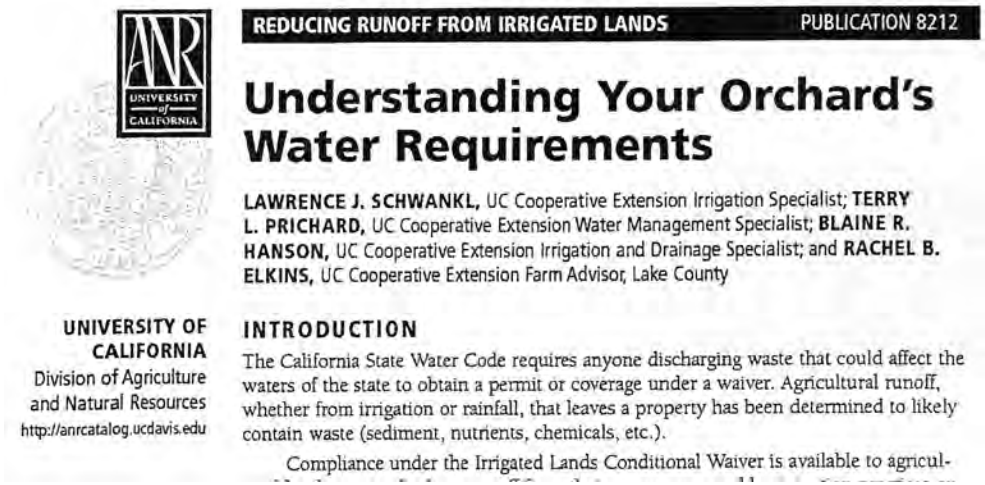
Crop ET = ETo x crop coefficient



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



REDUCING RUNOFF FROM IRRIGATED LANDS PUBLICATION 8212

Understanding Your Orchard's Water Requirements

LAWRENCE J. SCHWANKL, UC Cooperative Extension Irrigation Specialist; **TERRY L. PRICHARD,** UC Cooperative Extension Water Management Specialist; **BLAINE R. HANSON,** UC Cooperative Extension Irrigation and Drainage Specialist; and **RACHEL B. ELKINS,** UC Cooperative Extension Farm Advisor, Lake County

UNIVERSITY OF CALIFORNIA
Division of Agriculture and Natural Resources
http://anrcatalog.ucdavis.edu

INTRODUCTION

The California State Water Code requires anyone discharging waste that could affect the waters of the state to obtain a permit or coverage under a waiver. Agricultural runoff, whether from irrigation or rainfall, that leaves a property has been determined to likely contain waste (sediment, nutrients, chemicals, etc.).

Compliance under the Irrigated Lands Conditional Waiver is available to agricul-

http://anrcatalog.ucdavis.edu/SoilWaterIrrigation/8212.aspx

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.**

WEEKLY SOIL MOISTURE LOSS IN INCHES
(Estimated Evapotranspiration)
07/20/12 through 07/26/12

West of Sacramento River				East of Sacramento River		
Past Week of Water Use	Accum'd Seasonal Water Use	NOAA Forecasted Week of Water Use	**Crop (Leafout Date)**	Past Week of Water Use	Accum'd Seasonal Water Use	NOAA Forecasted Week of Water Use
1.85	29.49	1.90	Pasture	1.55	25.87	1.84
1.78	28.58	1.83	Alfalfa	1.48	24.98	1.77
1.38	22.20	1.43	Olives	1.17	19.65	1.38
1.22	19.25	1.24	Citrus	1.01	16.86	1.19
1.99	29.68	2.04	Almonds (3/1) *	1.69	26.13	1.98
1.78	25.94	1.83	Prunes (3/15) *	1.48	22.70	1.77
2.12	22.26	2.18	Walnuts (4/1) *	1.76	19.39	2.11
1.72	27.23	1.73	Urban Turf Grass	1.48	24.09	1.68

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……..)"

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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

REDUCING RUNOFF FROM IRRIGATED LANDS PUBLICATION 8216

Soil Intake Rates and Application Rates in Sprinkler-Irrigated Orchards

LAWRENCE J. SCHWANKL, UC Cooperative Extension Irrigation Specialist; **TERRY L. PRICHARD,** UC Cooperative Extension Water Management Specialist; **BLAINE R. HANSON,** UC Cooperative Extension Irrigation and Drainage Specialist

Available as a free download at:

http://anrcatalog.ucdavis.edu/SoilWaterIrrigation/8216.aspx

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".

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).

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Water use by the tree (gal/day)	=	Tree spacing (ft^2)	x	Tree water use (in/day)	x	0.623

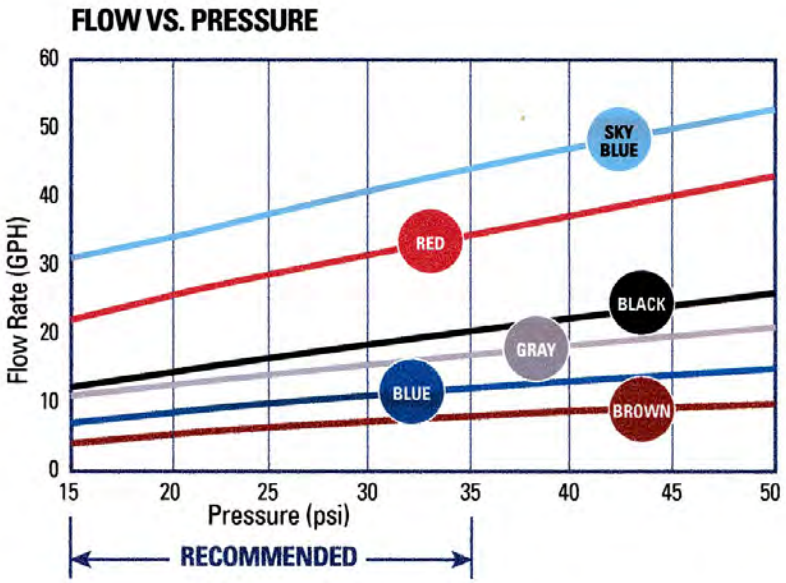
We can convert ET info. given in **inches/day** to ET info. in **gal/day**

Microirrigation Application Rate

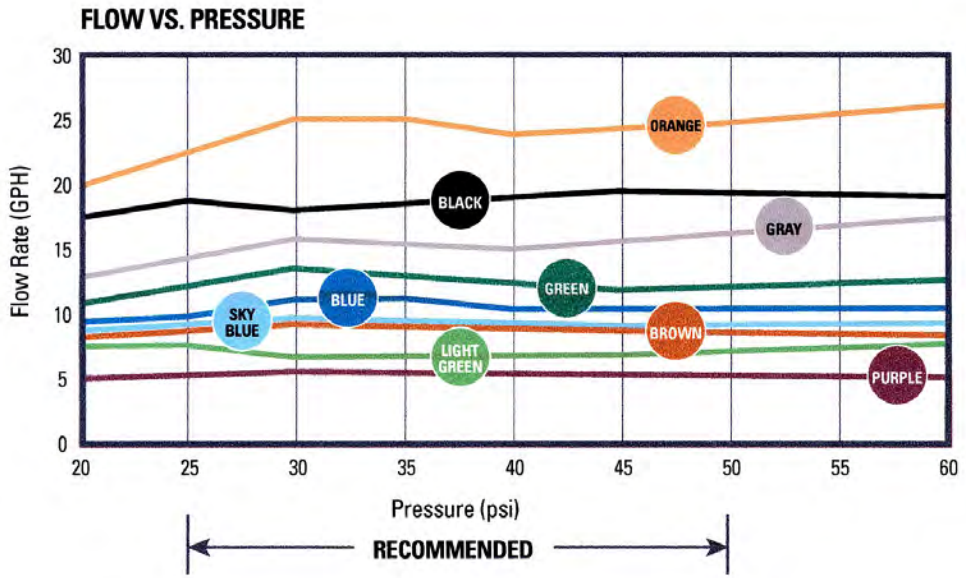
- Microsprinkler and drip system applications measured in units of "gal/hour" (gph).

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

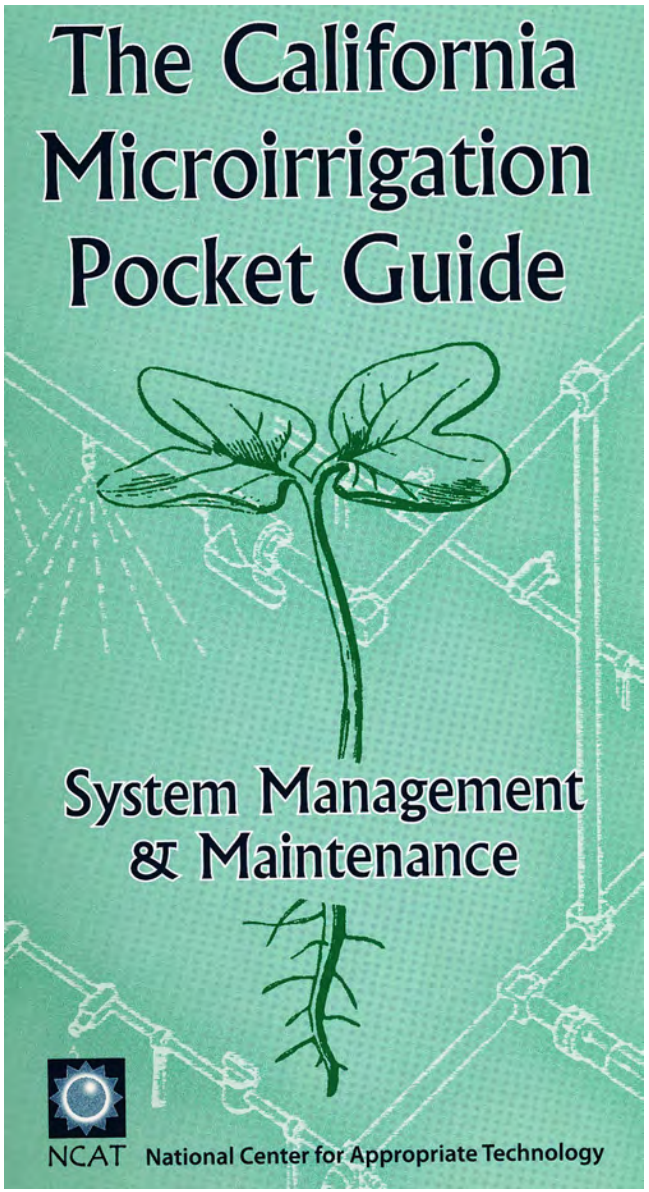
Non-pressure-compensating Micro

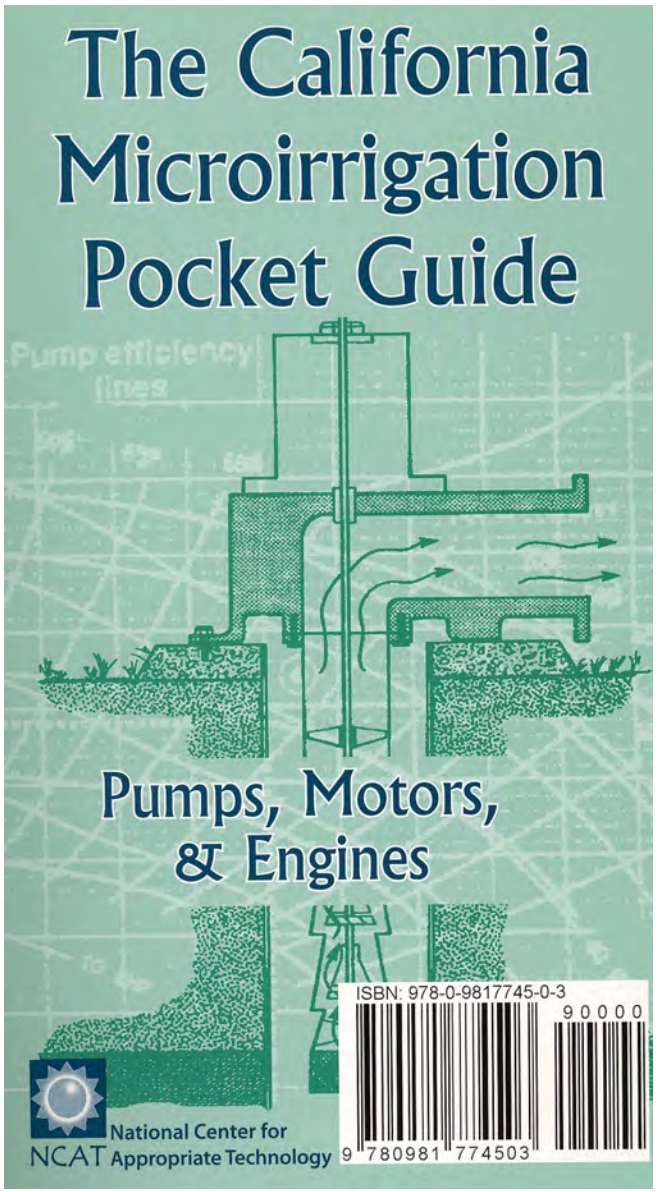


Pressure-compensating (PC) Micro



Managing Your Microirrigation System





Microirrigation Application Rate

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

Using Flowmeters to Find Your Application Rate

Every properly designed microirrigation system includes at least one flowmeter. Most often, this is a propeller flowmeter installed at the head of the system, in the main supply line—after the filters and on a straight section of pipe. Small flowmeters may also be installed on individual lateral lines.

Larry Schwankl photo

Figure 5. Saddle-type propeller flowmeter

Flowmeter at the Head of the System

If your flowmeter gives instantaneous readings in gallons per minute (gpm) or cubic feet per second (cfs), simply convert these readings into inches per hour as follows:

_____ gpm ÷ ____ irrigated area (acres) × 0.0022 =
_____ application rate (inches per hour)

_____ cfs ÷ ____ irrigated area (acres) × 0.992 =
_____ application rate (inches per hour)

If (unfortunately) there is no flowmeter on the system, you can still use the formulas above if you've recently had a pump test.

Instead of giving instantaneous readings, your flowmeter may record "totalized" flow in gallons, acre-feet, or acre-inches. To find your application rate, record the meter reading and time

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.

____ lateral length (feet) × ____ lateral spacing (feet) ÷ 43,560 = ____ irrigated area (acres)

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

____ applied water (ac-in/hr) ÷ ____ irrigated area (acres) = ____ application rate (in/hr)

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Efficient Irrigation Management

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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

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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

- What are we doing with soil moisture monitoring?

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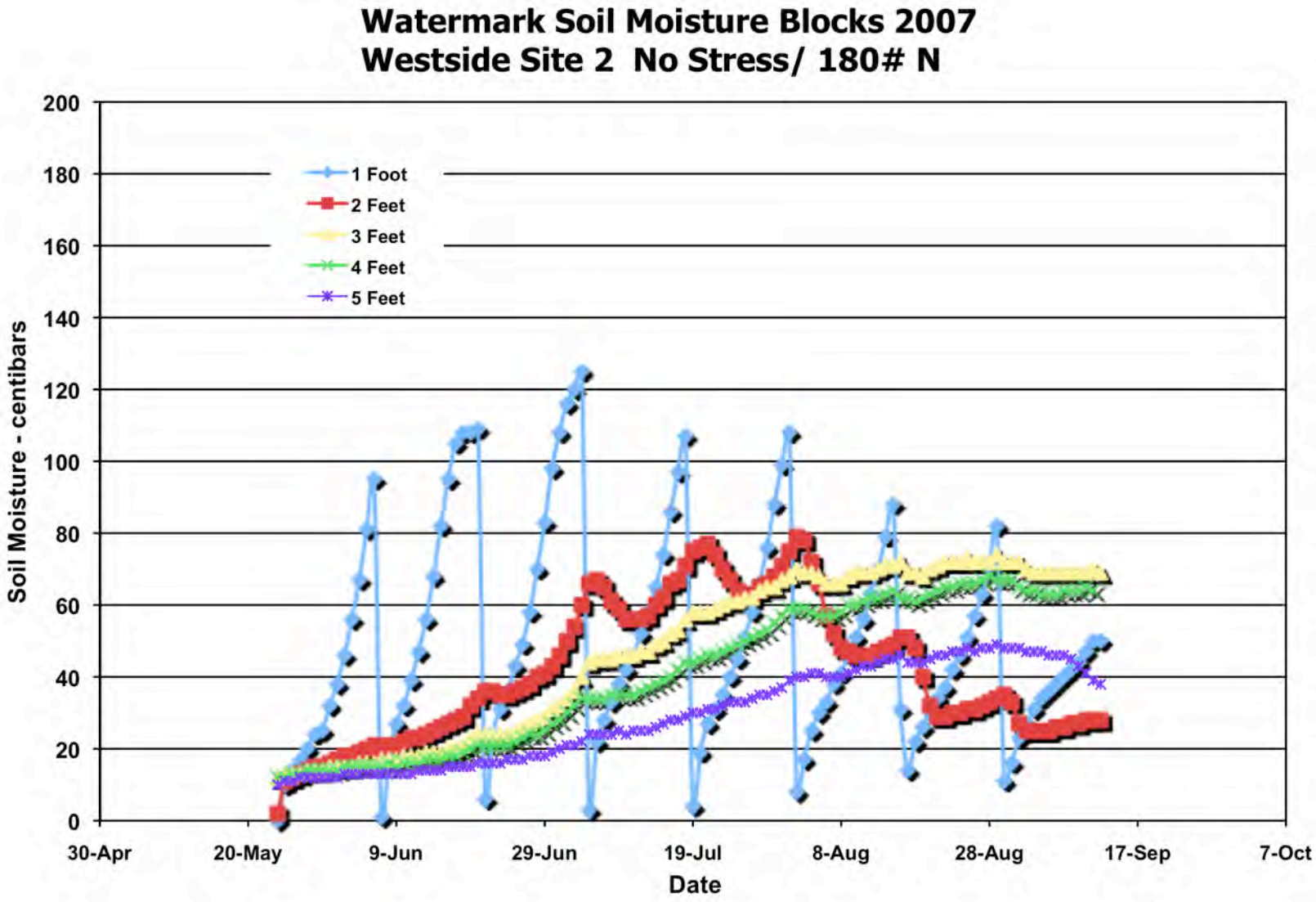
Soil Moisture Monitoring

- What are we doing with soil moisture monitoring?
  - 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



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 <u>all</u> 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.

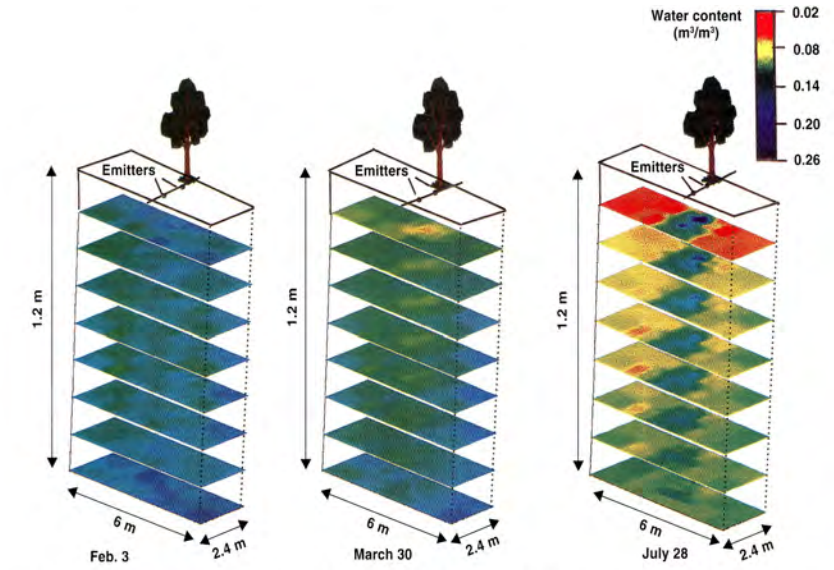
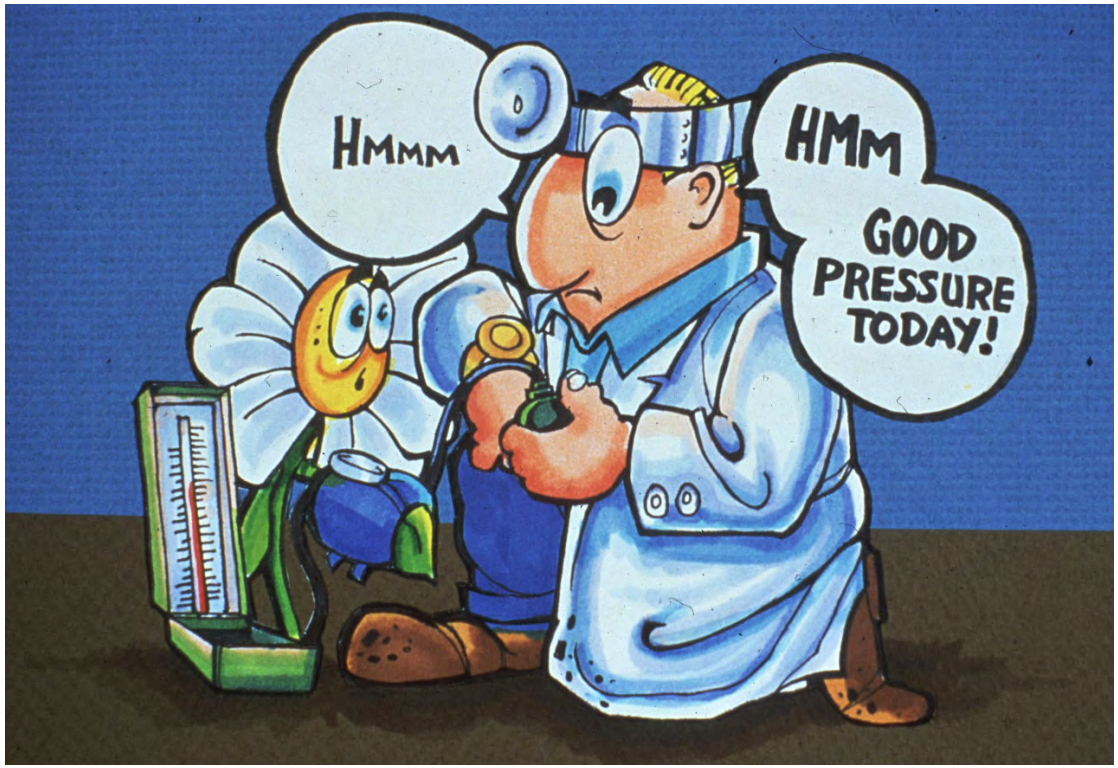


Fig. 1. Soil moisture distribution around an almond tree for 3 days in 1995: Feb. 3, soil moisture profile refilled by winter rains; March 30, soil moisture profile just before beginning irrigations; and July 28, soil moisture profile typical of that under surface drip irrigation during the growing season.

Efficient Irrigation Management

- **Plant-based Monitoring:**
  - **We actually monitor the plant to determine how well watered it is.**



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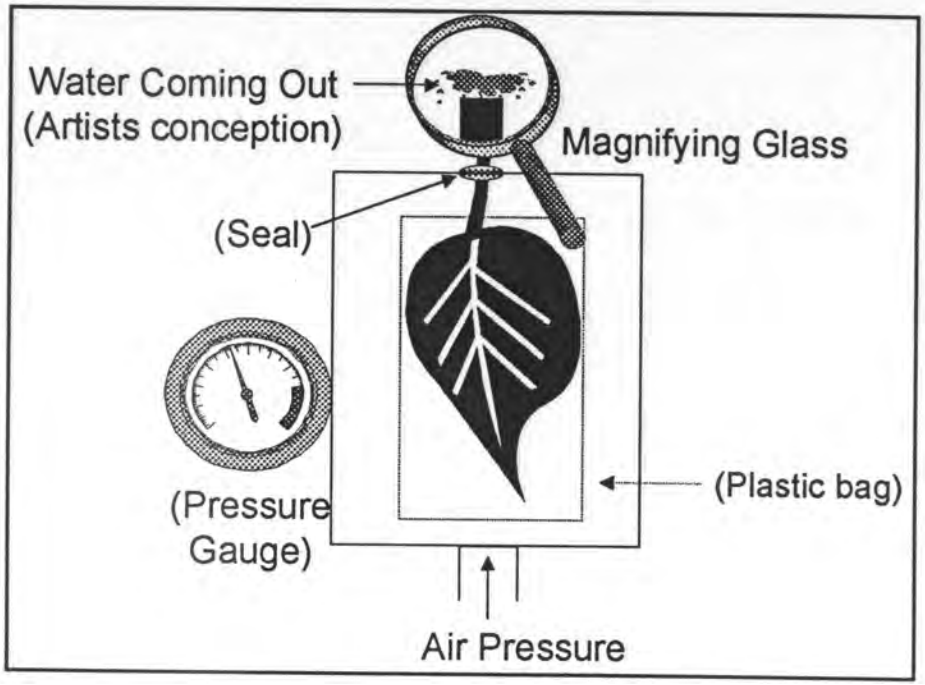
Pressure Bomb



Efficient Irrigation Management

- **Plant-based Monitoring:**
  - We actually monitor the plant to determine how well watered it is.

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.

Efficient Irrigation Management

- Record keeping!!!!
  - ET records.
  - Irrigation application records.
  - Soil moisture and/or pressure bomb records.

- **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?

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