

Water Management in Permanent Crops

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Water Management in Permanent Crops

What are the options?

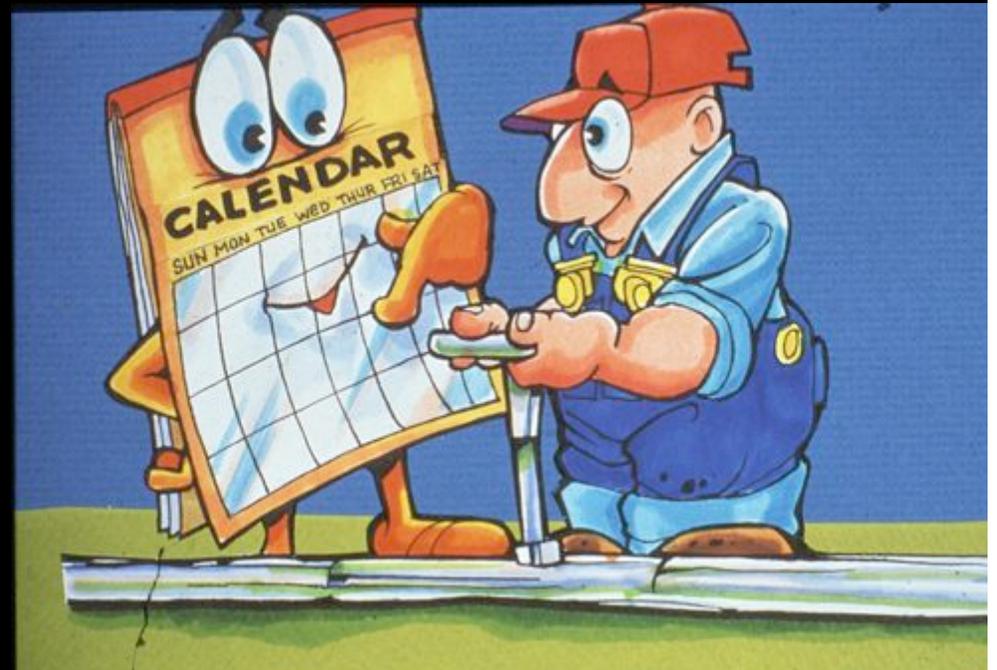
- I. Do a better job with the irrigation system you have.



Water Management in Permanent Crops

What are the options?

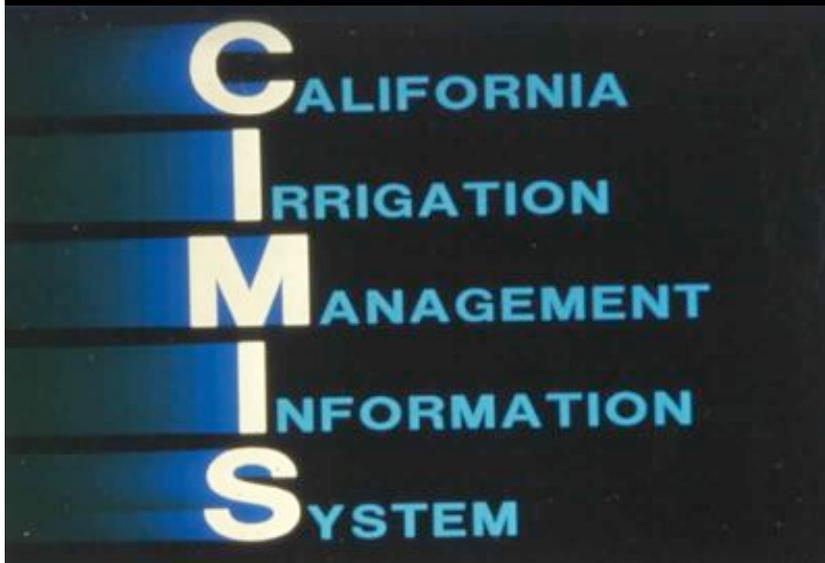
- I. Do a better job with the irrigation system you have.
 - Irrigation Scheduling – when & how much to apply.



Water Management in Permanent Crops

What are the options?

- I. Do a better job with the irrigation system you have.
 - Irrigation Scheduling – when & how much to apply.
 - ET scheduling with soil moisture monitoring backup.



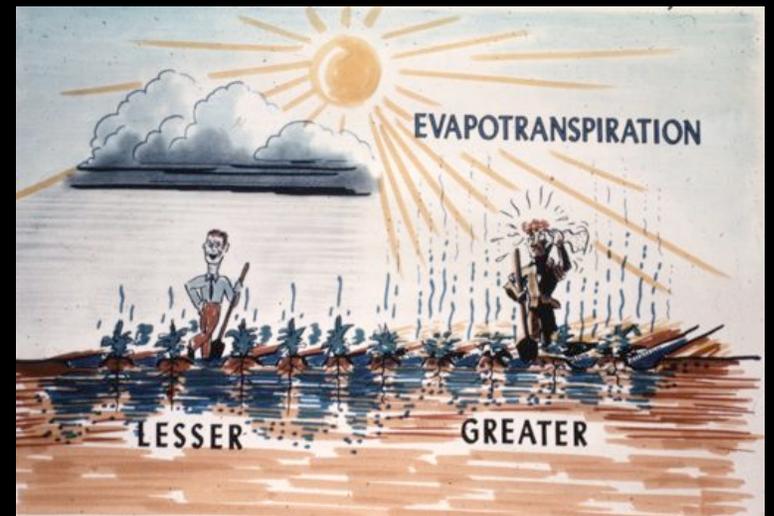
Irrigation Scheduling:

- Measure evapotranspiration (ET).

Evaporation from the soil

+

Transpiration from the plant



ET irrigation scheduling:

Accessing CIMIS data:

- Go through the Department of Water Resources

www.cimis.water.ca.gov

- Univ. of CA IPM website:

www.ipm.ucdavis.edu



CIMIS

CALIFORNIA IRRIGATION MANAGEMENT INFORMATION SYSTEM
DEPARTMENT OF WATER RESOURCES
OFFICE OF WATER USE EFFICIENCY



WELCOME

Help Center

Data

Resource Center

My CIMIS

General

Events

System News

FAQs

CIMIS Staff

Upcoming Events

Non-ideal site study update

New CIMIS Web Site

My CIMIS

Current System News

Station #176 (La Quinta) Disconnected

Station #27 (Zamora) disconnected

#177 Watsonville West

New Station #198 Costa Mesa

Welcome

CIMIS Overview

The California Irrigation Management Information System (CIMIS) is a program in the Office of Water Use Efficiency (OWUE), California Department of Water Resources (DWR) that manages a network of over 120 automated weather stations in the state of California. CIMIS was developed in 1982 by the California Department of Water Resources and the University of California at Davis to assist California's irrigators manage their water resources efficiently. Efficient use of water resources benefits Californians by saving water, energy, and money. [\(more...\)](#)

CIMIS Data Uses

Since the beginning of the CIMIS weather station network in 1982, the primary purpose of CIMIS was to make available to the public, free of charge, information useful in estimating crop water use for [irrigation scheduling](#). Although irrigation scheduling continues to be the main use of CIMIS, the uses have been constantly expanding over the years. At present, there are approximately 6,000 registered CIMIS users from diverse backgrounds accessing the CIMIS computer directly. It is estimated requests for CIMIS information on the WWW average about 70,000 per year. There are also many secondary suppliers of CIMIS weather data, such as other web sites, radio, newspapers, consultants, and local water agencies. [\(more...\)](#)

Irrigate like a Pro



CIMIS System Status:

The normal Maintenance window is:
Tuesday 04:00 - 06:00 PM

REGISTER

instant weather data access

[Go to the Department of Water Resources](#)

Real-time Reference ET (ETo)

Modesto - San Joaquin Valley - Station 71

Date	CIMIS ETo (in)	Precip (in)	Sol Rad (Ly/day)	Avg Vap (mBars)	Max Air Temp (°F)	Min Air Temp (°F)	Avg Air Temp (°F)	Max Rel Hum (%)	Min Rel Hum (%)	Avg Rel Hum (%)	Dew Pt (°F)	Avg wSpd (MPH)	Wnd Run (miles)	Avg Soil Temp (°F)
07/01/2009	0.27	0.00	682	15.6	91.2	56.1	72.2	90	32	58	56.5	5.0	121.4	74.1
07/02/2009	0.27	0.00	696	15.1	92.0	52.9	71.7	92	29	57	55.5	4.4	105.7	73.9
07/03/2009	0.28	0.00	713	14.1	91.9	52.2	72.4	90	25	52	53.8	5.2	124.7	73.7
07/04/2009	0.26	0.00	702	15.2	87.7	55.1	70.5	88	37	60	55.8	5.0	120.4	74.0
07/05/2009	0.26	0.00	679	14.2	83.2	53.0	66.4	92	40	64	54.0	6.7	161.9	73.8
07/06/2009	0.28	0.00	699	10.9	84.3	50.6	66.3	88	24	49	46.7	6.8	164.1	73.2
07/07/2009	0.28	0.00	706	11.1	84.6	46.1	65.9	92	26	51	47.3	5.2	126.6	72.8
07/08/2009	0.28	0.00	699	11.8	85.2	47.7	67.6	92	28	51	48.8	5.4	130.7	72.7
07/09/2009	0.28	0.00	712	11.3	85.5	47.2	67.4	94	26	49	47.8	5.9	141.9	72.6
07/10/2009	0.29	0.00	720	11.2	86.8	47.1	68.7	92	22	47	47.4	5.6	135.3	72.5
07/11/2009	0.21	0.00	495	11.7	84.0	55.4	70.2	78	27	46	48.7	5.6	136.2	72.7
07/12/2009	0.23	0.00	488	10.3 Y	86.1	57.6	72.7	68	22	37 Y	45.2 Y	6.0	144.6	72.7
07/13/2009	0.30	0.00	728	12.2	89.7	48.4	71.1	84	24	47	49.9	6.9	166.3	72.4
07/14/2009	0.30	0.00	703	14.3	96.3	57.6	78.4	79	25	43	54.1	5.7	136.4	74.1
07/15/2009	0.28	0.00	698	15.5	96.5	57.6	76.9	89	25	49	56.3	4.3	103.3	75.1
Tots/Avgs	4.07	0.00	675	13.0	88.3	52.3	70.6	87	27	51	51.2	5.6	134.6	73.4

Evapotranspiration Estimation:

- CIMIS weather stations predict the ET of pasture grass (Reference ET = ET_0).
- Convert the reference ET (ET_0) to your crop's ET (ET_{crop}) using a crop coefficient (k_c).

Determining Crop ET:

Crop ET = Reference ET x Crop Coefficient

$$ET_{\text{crop}} = ET_0 \times k_c$$

Crop Coefficients: CIMIS website or

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

Convert tree water use (in/day to gal/day for microirrigation systems):

$$\begin{array}{ccccccc} \text{Water use} & & \text{Tree} & & \text{Tree water} & & \\ \text{by the tree} & = & \text{spacing} & \times & \text{use} & \times & 0.623 \\ \text{(gal/day)} & & \text{(ft}^2\text{)} & & \text{(in/day)} & & \end{array}$$

Example: Tree spacing = 16 ft. x 22 ft. = 352 ft²

Tree water use = 0.25 in./day

$$\begin{array}{l} \text{Water use by} \\ \text{the tree} \\ \text{(gal/day)} \end{array} = 352 \text{ ft}^2 \times 0.25 \text{ in/day} \times 0.623 = 55 \text{ gal/day}$$

Historical ET estimates:

Almond historical ET - inches during period

Table 1. Almond historical evapotranspiration estimates (inches during period)

Date	Red Bluff	Williams	Modesto	Madera	Parlier	Visalia	Bakersfield
Mar 16-31	0.96	0.95	1.04	1.04	1.12	1.12	1.21
Apr 1-15	1.80	1.26	1.26	1.26	1.53	1.44	1.53
Apr 16-30	2.40	1.68	1.78	1.78	1.88	1.98	1.98
May 1-15	2.70	2.08	2.08	2.19	2.41	2.30	2.63
May 16-31	2.80	2.65	2.91	2.78	3.03	2.91	3.29
June 1-15	2.85	2.90	3.28	3.15	3.28	3.28	3.40
June 16-30	3.00	3.35	3.35	3.48	3.48	3.48	3.61
July 1-15	3.30	3.91	3.63	3.91	3.77	3.77	3.91
July 16-31	3.68	4.21	3.91	4.21	3.76	4.06	4.36
Aug 1-15	3.45	3.53	3.38	3.67	3.38	3.53	3.95
Aug 16-31	3.52	3.31	3.01	3.31	3.31	3.31	3.76
Sept 1-15	2.85	2.68	2.68	2.82	2.68	2.96	2.96
Sept 16-30	2.25	2.18	2.05	2.18	2.05	2.32	2.46
Oct 1-15	1.80	1.66	1.66	1.66	1.66	1.79	1.91
Oct 16-31	1.28	1.14	1.14	1.14	1.14	1.26	1.64
Nov 1-15	0.75	0.63	0.74	0.74	0.74	0.84	0.84

Source: <http://anrcatalog.ucdavis.edu/SoilWaterIrrigation/8212.aspx>

Determining Crop ET:

Using ET info. tells you when and how much to irrigate.

Works very well when verified using soil monitoring.

Soil Moisture Monitoring:



Irrigation Scheduling helps you be an **Efficient** irrigator.

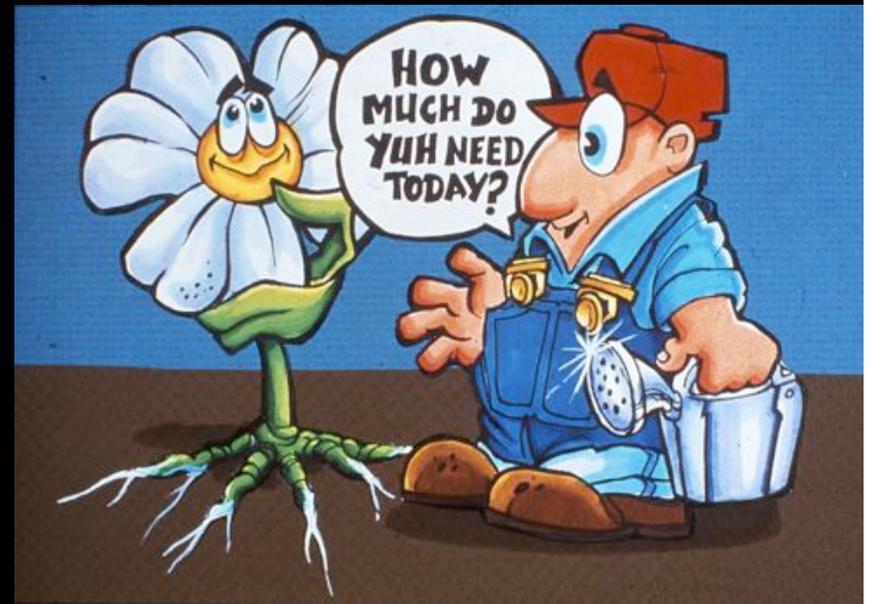
What is Being Efficient?

- Only putting on as much water as the trees or vines *need*.



What is Being Efficient?

- Only putting on as much water as the trees or vines *need*.
- Most of the water need is for evapotranspiration (ET), but part of the need can be for salinity control, etc.



What is Irrigation Efficiency?

- Irrigation Efficiency
 - What portion of the applied water is beneficially used?

Beneficial Uses

Plant water needs

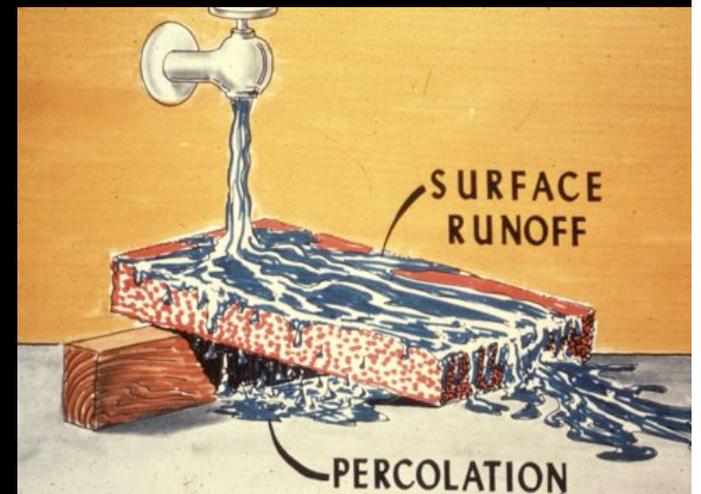
Salinity control

Frost protection

Losses

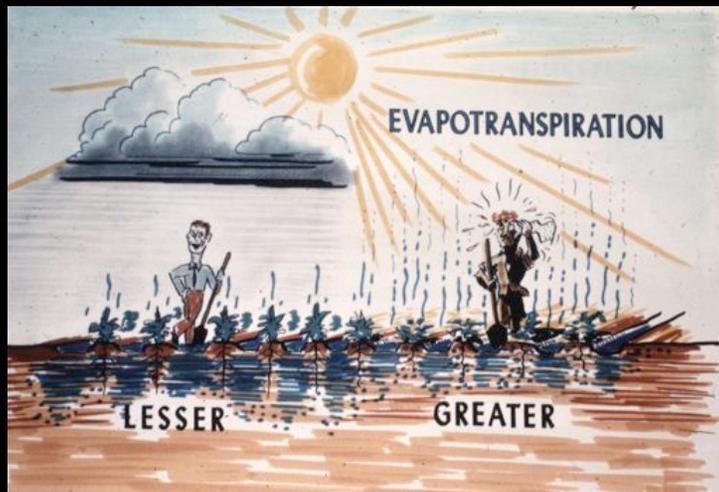
Deep percolation

Runoff not reused



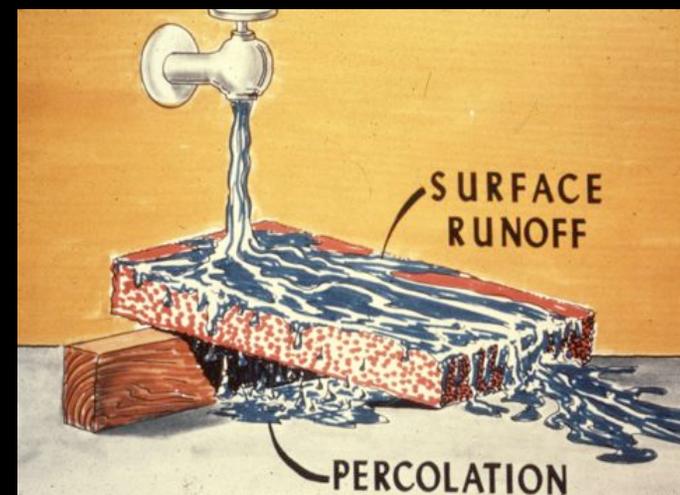
Irrigation Efficiency

- Irrigation Efficiency
 - What portion of the applied water is beneficially used?
 - Plant water needs (Evapotranspiration = ET) is the predominant beneficial use.



What is Irrigation Efficiency?

- Irrigation Efficiency
 - What portion of the applied water is beneficially used?
 - Plant water needs (Evapotranspiration = ET) is the predominant beneficial use.
 - Runoff is *usually* not a problem when using microirrigation, but can be with sprinkler or surface irrigation.



Irrigation Efficiency

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 - Irrigation efficiency compares how much water you apply with how much the orchard or vineyard needs (usually from ET info.).

Irrigation Efficiency

- Irrigation Efficiency
 - Irrigation efficiency compares how much water you apply with how much the orchard or vineyard needs (usually from ET info.).
 - Know the application rate.

Document to download
at website:

<http://schwankl.uckac.edu>

Orchard Irrigation
Determining the Application Rate & Uniformity of a
Microirrigation System

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Irrigation Efficiency

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 - Irrigation efficiency compares how much water you apply with how much the orchard needs (usually from ET info.).
 - It does not tell you anything about where the water was applied. Was it evenly applied across the whole orchard?

Irrigation Efficiency & Irrigation Uniformity

- Irrigation Efficiency
 - Irrigation efficiency compares how much water you apply with how much the orchard needs (usually from ET info.).
 - It does not tell you anything about where the water was applied. Was it evenly applied across the whole orchard or vineyard?
 - To describe where it is applied, we use **Irrigation Uniformity**.

Irrigation Uniformity?

- Irrigation Uniformity
 - Measure of how evenly the water was applied.

$$\text{Emission Unif. (EU-\%)} = \frac{\text{Avg. discharge of low 25\% of emitters}}{\text{Avg. of all sampled emitters}} \times 100$$

- Uniformity needs to be measured in the orchard or vineyard. Pretty easy with sprinklers or microirrigation systems. Really tough with surface irrigation.

Irrigation Uniformity

- Irrigation Uniformity
 - What is the impact of poor irrigation uniformity?
 - Some plants are over-watered, some are under-watered, some plants get the correct amount.



Irrigation Uniformity

- Irrigation Uniformity
 - What is the impact of poor irrigation uniformity?
 - Some plants are over-watered, some plants are under-watered, some plants get the correct amount.
 - To make sure that most trees or vines get adequate water, we end up over-watering much of the orchard or vineyard.

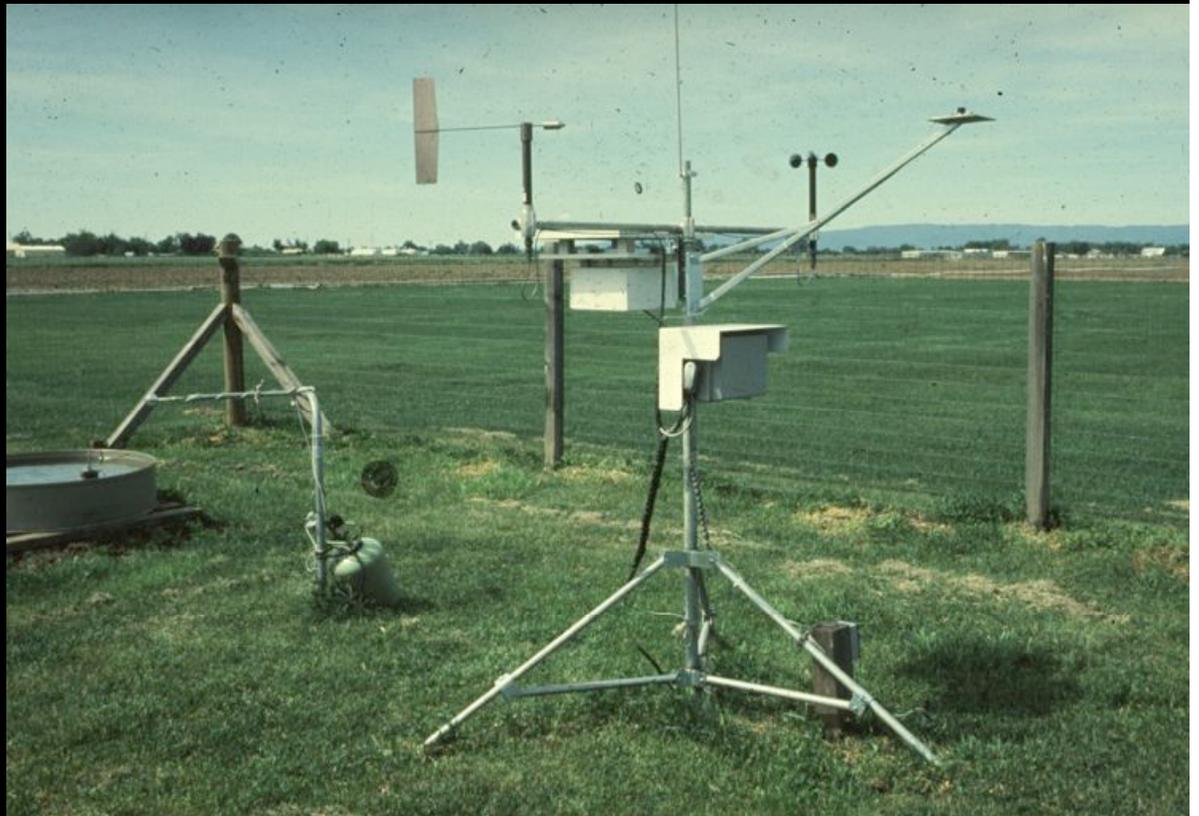


New Irrigation System:

If can't achieve the irrigation efficiency you want using your current irrigation system, replace existing system with a **new** irrigation system (usually solid-set sprinklers or microirrigation).

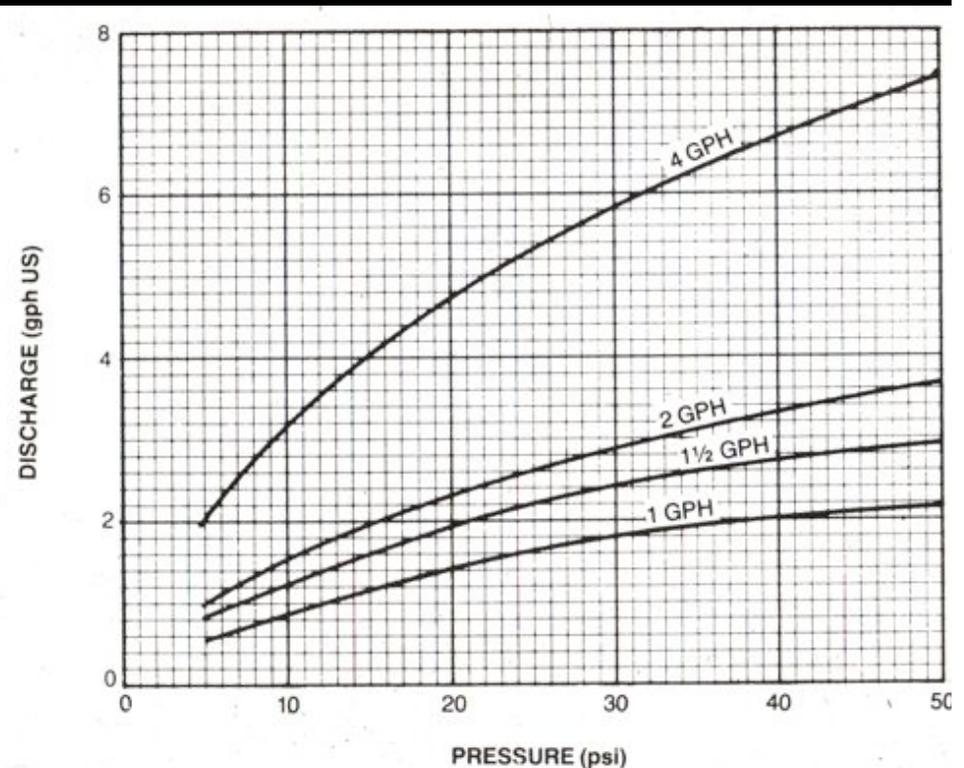
New Irrigation System:

- Still need to do good irrigation scheduling.



New Irrigation System:

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- Still need to know application rate so can run the system for the correct time.



New Irrigation System:

- **Still need to do good irrigation scheduling.**
- **Still need to know application rate so can run the system for the correct time.**
- **So, what did you gain?**

New Irrigation System:

- Still need to do good irrigation scheduling.
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- So, what did you gain?
 1. Improved Irrigation Uniformity.



New Irrigation System:

- Still need to do good irrigation scheduling.
- Still need to know application rate so can run the system for the correct time.
- **So, what did you gain?**
 1. Improved Irrigation Uniformity.
 2. **CONTROL** over water applications.
 - Ability to apply a small amount of water frequently.



New Irrigation System:

- Still need to do good irrigation scheduling.
- Still need to know application rate so can run the system for the correct time.
- **So, what did you gain?**
 1. Improved Irrigation Uniformity.
 2. CONTROL over water applications.
 3. Control plant water status to keep plant happy all the time.
 - If vines, can intentionally deficit irrigate.



New Irrigation System:

- Still need to do good irrigation scheduling.
- Still need to know application rate so can run the system for the correct time.
- **So, what did you gain?**
 1. Improved Irrigation Uniformity.
 2. **CONTROL** over water applications .
 3. Control plant water status to keep plant happy all the time.
 4. **You are now poorer - \$1000/acre or more.**

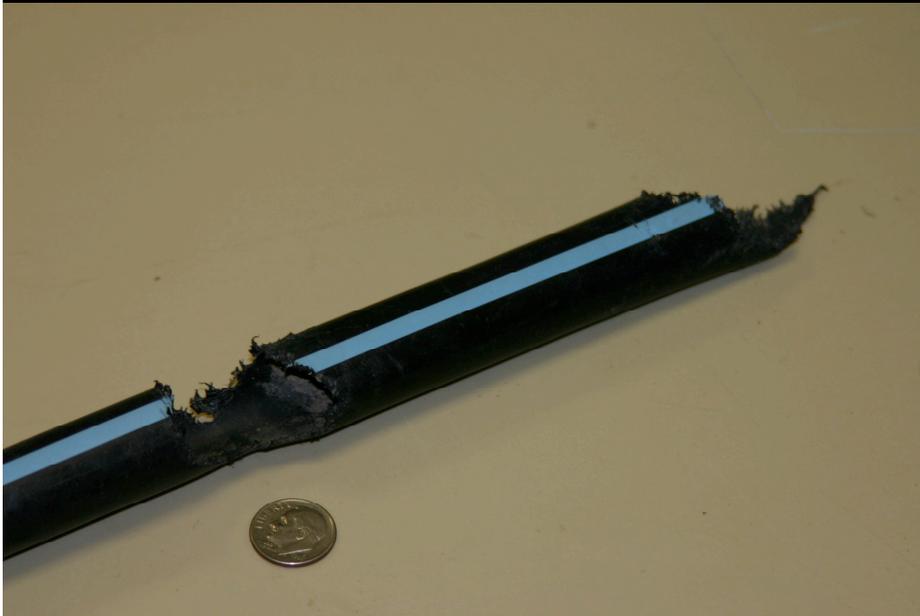
New Irrigation System

- **What Do You Need to Look Out For?**

New Irrigation System

What Do You Need to Look Out For?

- Microirrigation
 - Maintenance – Clogging & Leaks



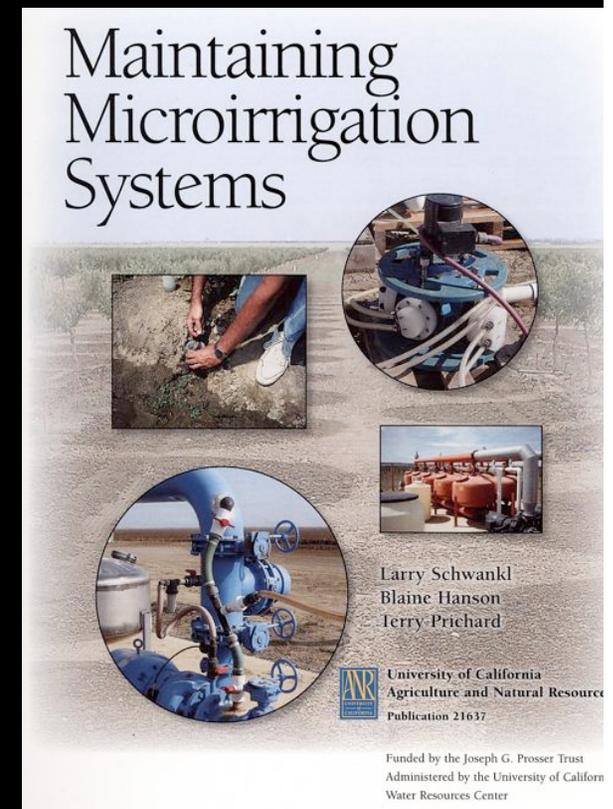
New Irrigation System

What Do You Need to Look Out For?

- Microirrigation
 - Maintenance – Clogging & Leaks

Available at:

<http://anrcatalog.ucdavis.edu/Irrigation/21637.aspx>



New Irrigation System

What Do You Need to Look Out For?

- Microirrigation
 - Maintenance – Clogging & Leaks
 - Long Irrigation Set Times



New Irrigation System

What Do You Need to Look Out For?

- Microirrigation
 - Maintenance – Clogging & Leaks
 - Long Irrigation Set Times
 - Limited stored soil moisture



Questions?

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For Powerpoint presentation and microirrigation system evaluation
handout, go to:

<http://schwankl.uckac.edu>