Irrigation Scheduling

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Determining an Irrigation Schedule

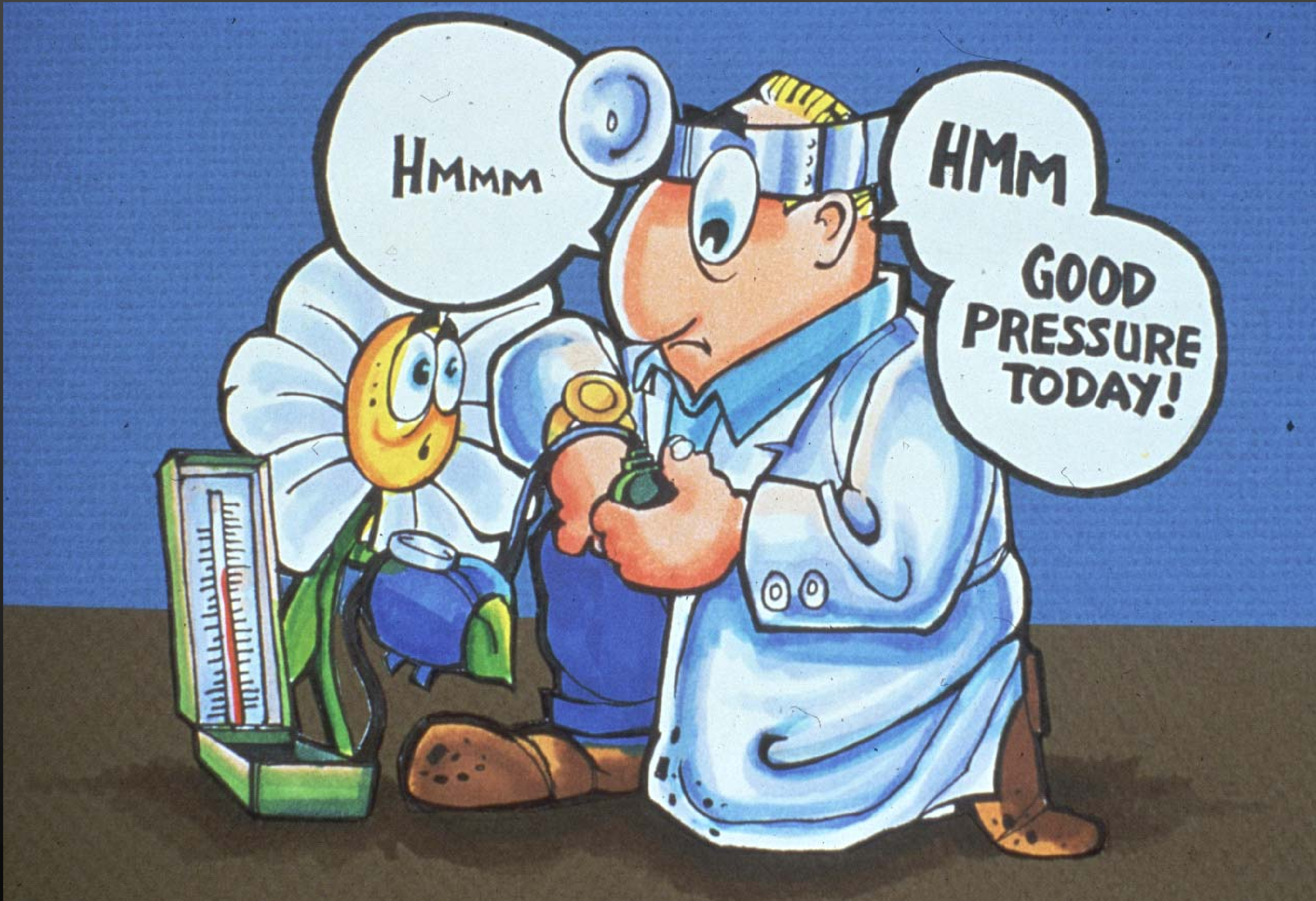
Step 1: Determine how much water the trees are using - how much you want to apply.

Step 2: Determine the application rate of the irrigation system.

Step 3: Determine the irrigation hours.

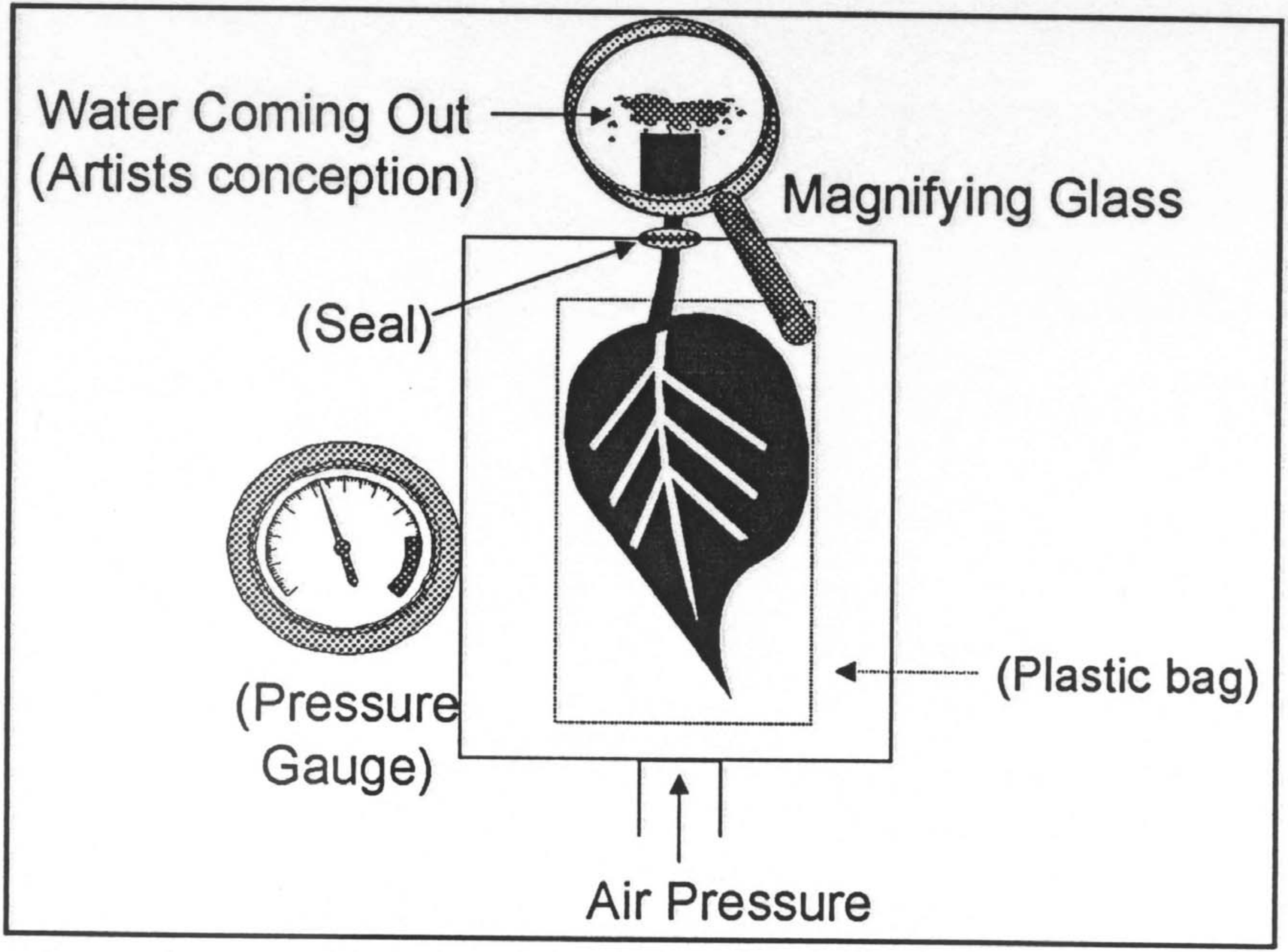
Irrigation Scheduling - Methods

1. Monitor the plant.
2. Monitor the soil.
3. Monitor the weather.


HMMM
HMM
GOOD PRESSURE TODAY!

Plant monitoring:

- Pressure chamber (pressure bomb).


Water Coming Out
(Artists conception)
Magnifying Glass
(Seal)
(Pressure
Gauge)
(Plastic bag)
Air Pressure

Plant monitoring:

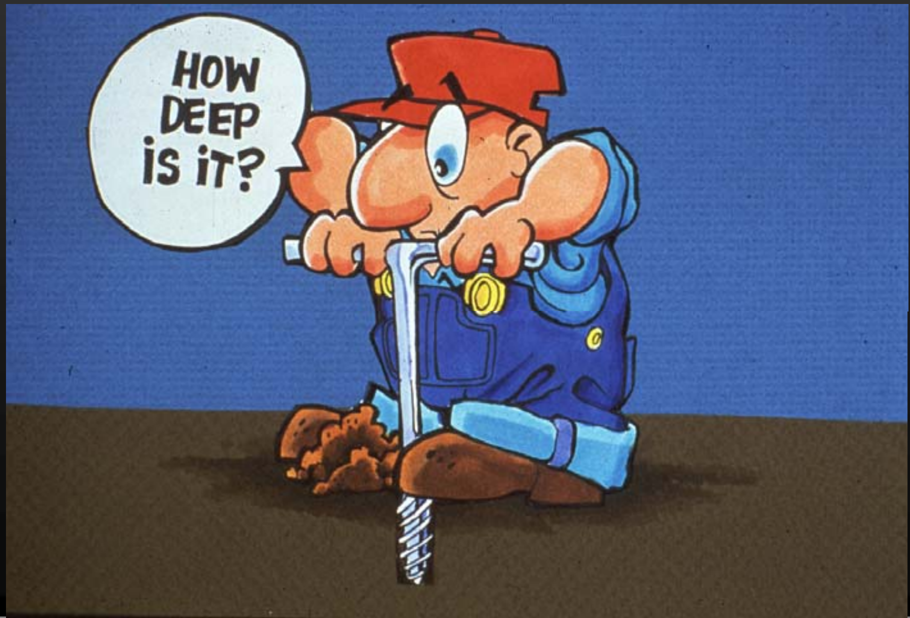
- Plant monitoring tells us **when** to irrigate, but it doesn't tell us **how much** to irrigate.

Irrigation Scheduling - Methods

1. Monitor the tree.
2. Monitor the soil.
3. Monitor the weather.

Tools for Monitoring Soil Moisture

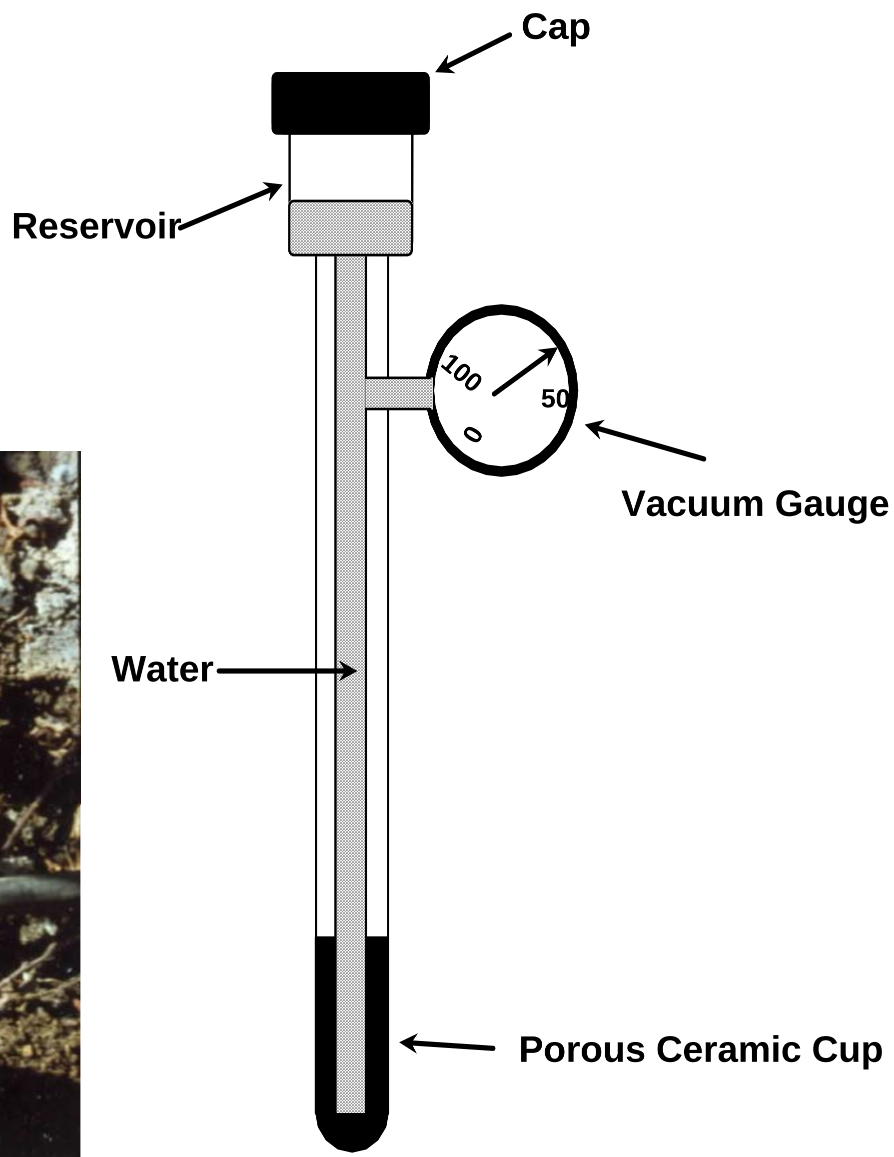
- Augers, push probes, shovels, etc.
  - Don’t discount it just because it isn’t fancy.
  - Works well for checking out problems.



Tools for Monitoring Soil Moisture

- Augers, push probes, shovels, etc.
- Tensiometers

Tensiometers



Tensiometers

- Measures soil moisture tension.

Tensiometers

- *Tells you when to irrigate* ***<u>but not how much</u>***

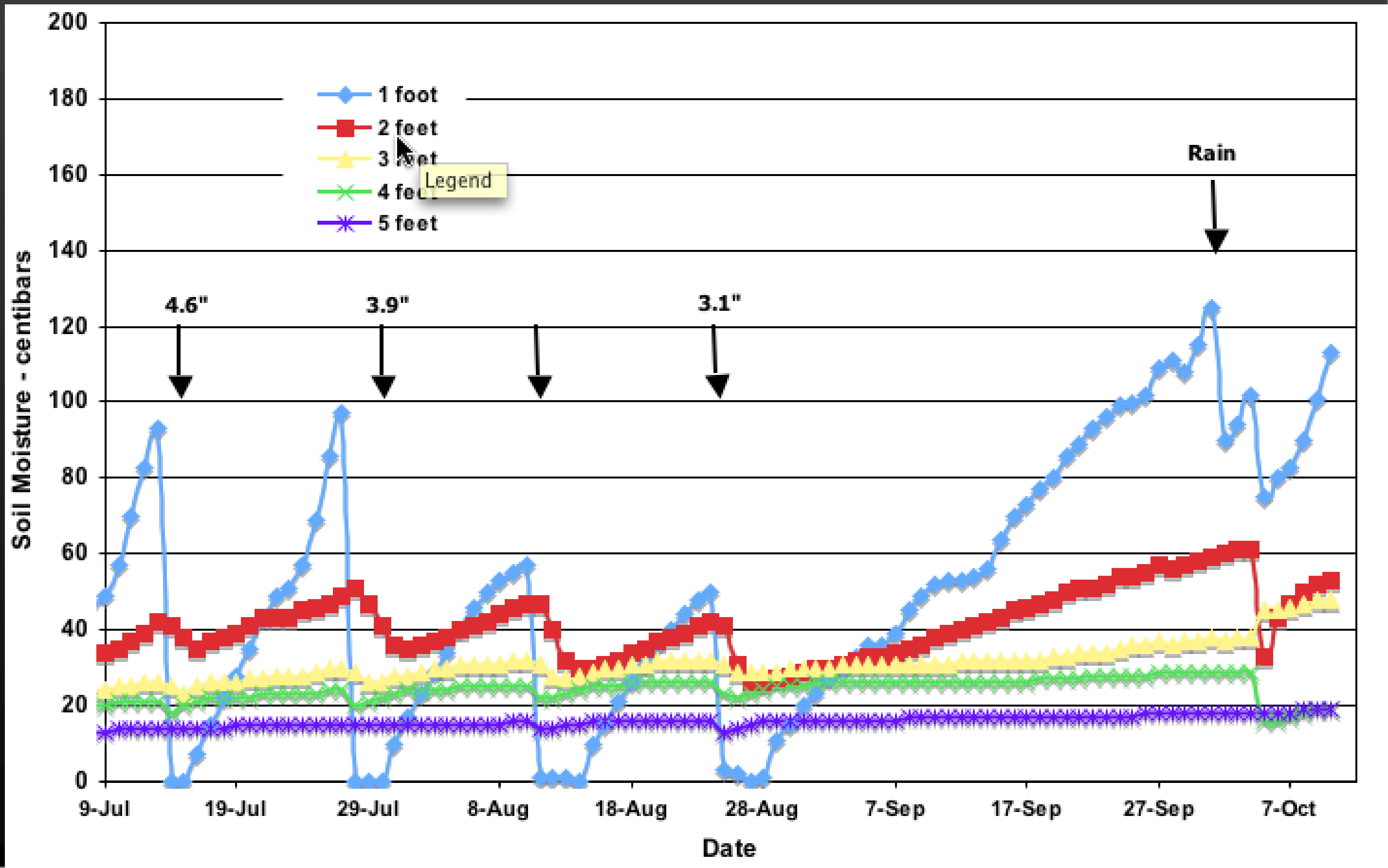
Tools for Monitoring Soil Moisture

- Augers, push probes, shovels, e
- Tensiometers
- Electrical resistance blocks

Soil Moisture Blocks

Electrical Resistance Blocks

- Can be used with a data logger to keep record - very handy.



Electrical Resistance Blocks

- **Can be used with a data logger to keep record - very handy.**
- ***Tells you when to irrigate but not how much***

Tools for Monitoring Soil Moisture

- Augers, push probes, shovels, etc.
- Tensiometers
- Electrical resistance blocks
- **Dielectric constant devices**

Dielectric Constant Devices

- Dielectric constant is a measure of the ability of a material to establish an electric field.
  - The dielectric constant for soil is much different than for water.

Dielectric Constant Devices

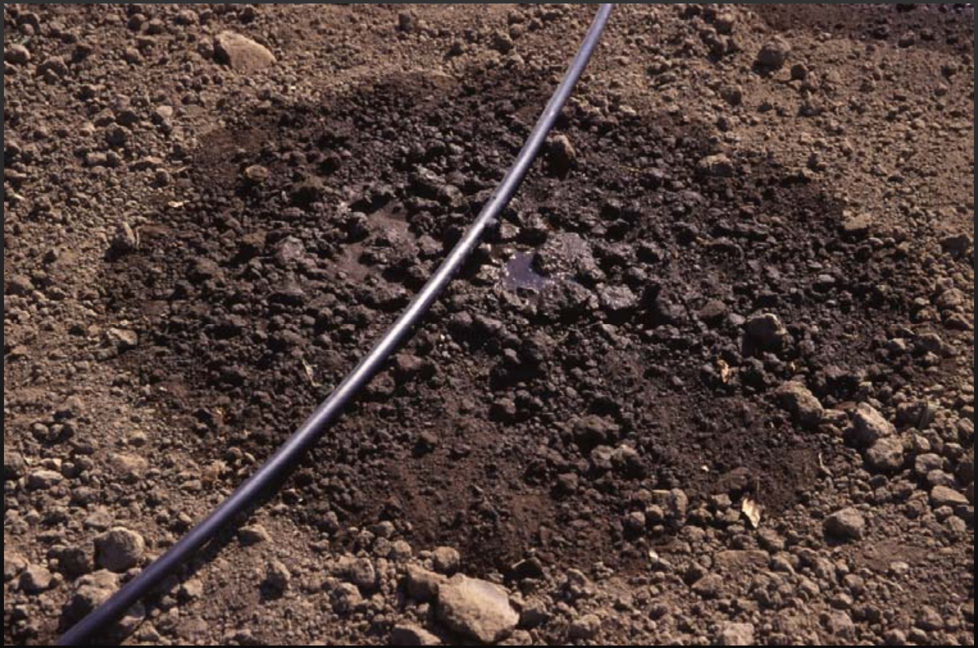
- Can be used with a data logger for continual readings.
- Cost

When calibrated, dielectric constant devices tell you when <u>and</u> how much to irrigate.

Soil Moisture Monitoring

An important issue is placement of the soil moisture monitoring device!!!

- Particularly an issue with microirrigation.



Irrigation Scheduling - Methods

1. Monitor the tree.
2. Monitor the soil.
3. Monitor the weather.

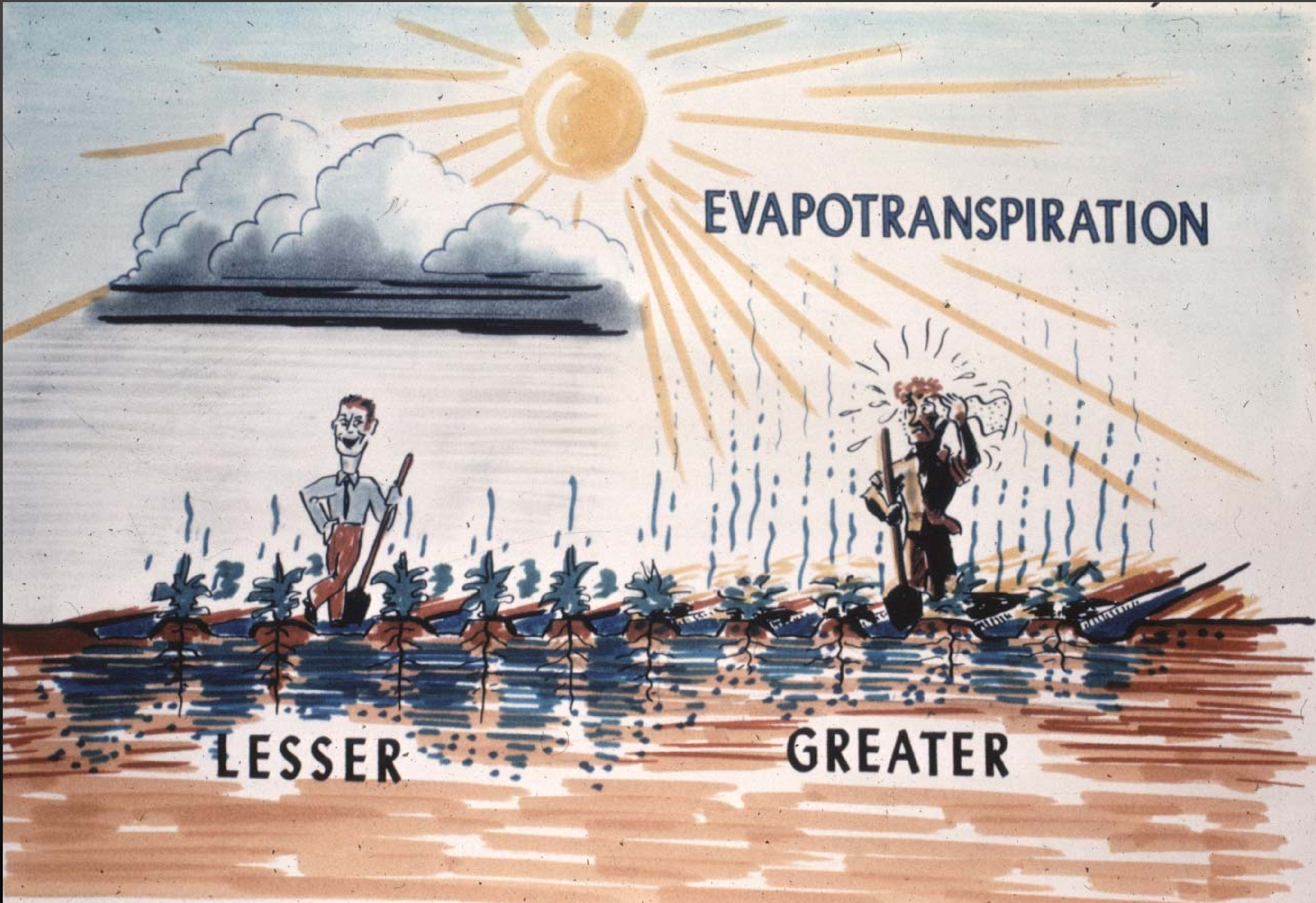
Weather monitoring:

- Measure evapotranspiration (ET).

Evaporation from the soil

\+

Transpiration from the plant


EVAPOTRANSPIRATION
LESSER
GREATER

Weather monitoring:

- Evapotranspiration estimates:
  - Historical averages.
  - Real-time measurements.

Where do you get ET estimates?

Historical ET estimates:

Citrus historical ET - in/day during period

Date	Orland Citrus ET in/day
Mar 16-31	0.05
Apr 1-15	0.08
Apr 16-30	0.09
May 1-15	0.11
May 16-31	0.11
Jun 1-15	0.14
Jun 16-30	0.15
July 1-15	0.17
July 16-31	0.17
Aug 1-15	0.19
Aug 16-31	0.15
Sept 1-15	0.15
Sept 16-30	0.12
Oct 1-15	0.11
Oct 16-31	0.08
Nov 1-15	0.04
Nov 16-30	0.03
Dec 1-15	
Dec 16-31	
Total	29.61

Real-Time Weather Monitoring:

- Measure evapotranspirtation (ET).
- CIMIS weather stations predict the ET of pasture grass (Reference ET = ET_o).

CALIFORNIA

IRRIGATION

MANAGEMENT

INFORMATION

SYSTEM

Accessing CIMIS data:

- Go through the Department of Water Resources

  www.cimis.water.ca.gov

- Univ. of CA IPM website:

  www.ipm.ucdavis.edu

CALIFORNIA THE GOLDEN STATE

California Homepage | Governor's Homepage

CIMIS

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

Welcome | Info 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

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 Resource 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

Weather monitoring:

- Measure evapotranspirtation (ET).
- Weather stations predict the ET of pasture grass (Reference ET = ET_o).
- Convert the reference ET (ET_o) to your crop's ET (ET_{crop}) using a crop coefficient (k_c).

Determining Crop ET:

Crop ET = Reference ET x Crop Coefficient

$$ET_{crop} = ET_o \times k_c$$

Crop Coefficient for Citrus (k_c) = 0.65

Irrigation scheduling example:

Orland - Sacramento Valley - Station 61

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)
07/01/2008	0.23	0.00	601	17.2	90.7	57.0	74.6	97	26	59	59.2	3.3	80.8	79.5
07/02/2008	0.24	0.00	579	18.1	91.1	59.8	76.4	96	35	58	60.7	4.3	104.8	80.1
07/03/2008	0.26	0.00	261	17.6	91.4	-- S	81.0	90	34	49	59.9	9.4 R	225.9 R	83.8
07/04/2008	0.22	0.00	609	17.8	83.0	61.3	71.5	94	40	68	60.2	4.1	99.9	81.0
07/05/2008	0.20	0.00	531	19.2	92.0	60.4	76.3	97	31	62	62.3	2.6	63.5	81.0
07/06/2008	0.26	0.00	610	20.3	98.1	61.8	81.1	97	25	56	63.9	3.8	90.9	81.7
07/07/2008	0.30 R	0.00	598	18.1	109.7 Y	65.2	88.1	94	11	40	60.6	5.0	121.6	82.9
07/08/2008	0.25 R	0.00	441	12.0	103.6 Y	69.9	91.1 H	69 H	13 H	24	49.3	6.2	149.4	82.9
07/09/2008	0.23 R	0.00	503	19.2	109.6 Y	64.7	86.4	93	11	45	62.4	3.2	77.2	82.3
07/10/2008	0.18	0.00	425	21.9	100.3	69.0	83.3	93	21	56	66.1	3.1	73.7	82.4

Citrus water use example:

Date	ET_o (in.)	k_c	ET_{citrus} (in.)
7/4/08	0.22	0.65	0.14

$$ET_{crop} = ET_o \times k_c$$

Determining Crop ET:

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

Works very well when verified using plant or soil monitoring.

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

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

Example: Tree spacing = 11 ft. x 20 ft. = 220 ft^2

Tree water use = 0.14 in./day

Water use by:
the tree
(gal/day)

= 220 ft^2 x 0.14 in/day x 0.623

= 19 gal/day

Table 1. Tree water use (gallons/day) for various plant spacing and tree water use (in/day).

Tree spacing (ft^2)	ET (in/day)							
	0.05	0.1	0.15	0.2	0.25	0.3	0.35	0.4
50	2	3	5	6	8	9	11	12
100	3	6	9	12	16	19	22	25
150	5	9	14	19	23	28	33	37
200	6	12	19	25	31	37	44	50
250	8	16	23	31	39	47	55	62
300	9	19	28	37	47	56	65	75
350	11	22	33	44	55	65	76	87
400	12	25	37	50	62	75	87	100
450	14	28	42	56	70	84	98	112
500	16	31	47	62	78	94	109	125

Tree spacing (ft^2) = row spacing (ft) x tree spacing with the row (ft)

Determine irrigation system application rate:

Application rate (gal/hr) = Number of emission devices x Discharge rate per emission device (gal/hr/emitter)

Example: Microsprinklers: 1 microsprinkler per tree
Discharge rate per micro: 10 gal/hr.

Application rate (gal/hr): = 1 micro/tree x 10 gal/hr per microsprinkler
= 10 gal/hr.

Determine hrs. of operation/day:

Hours of operation per day = $\frac{\text{Tree water use (gal/day)}}{\text{Application rate (gal/hr)}}$

Example:

Microsprinklers: Tree water use (gal/day) = 19 gal/day
Application rate (gal/hr) = 10 gal/hr

Hours of operation per day = 19 gal/day ÷ 10 gal/hr
= 2 hrs/day

Choose irrigation frequency to match your conditions.

Questions?

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