Irrigating Efficiently

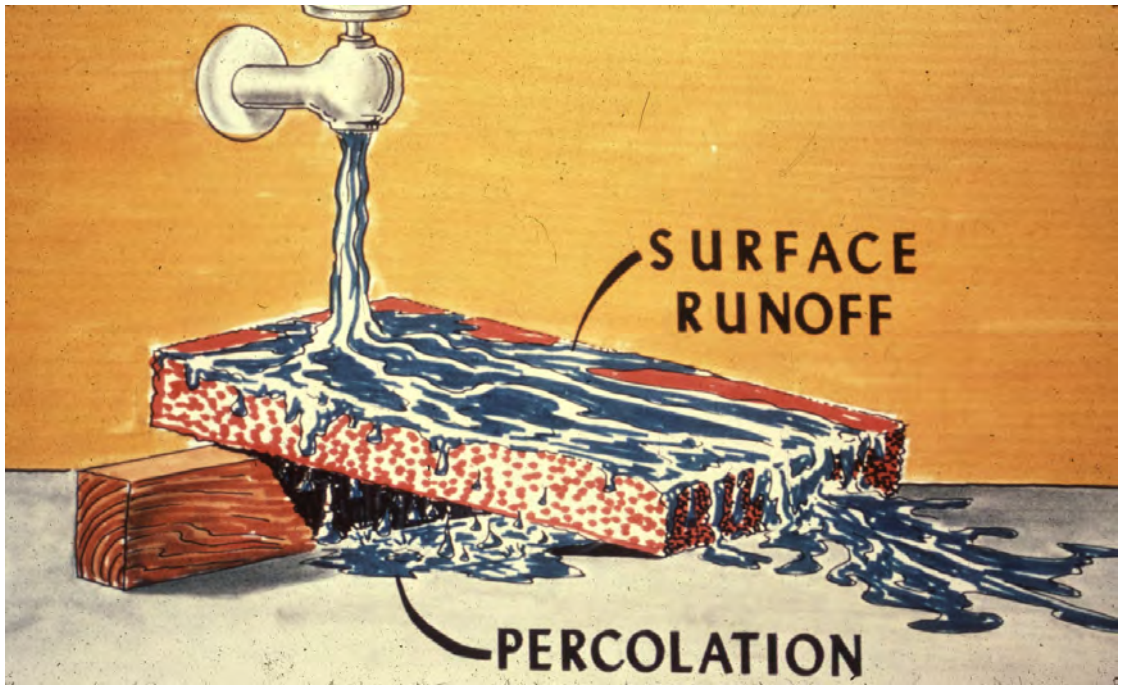
Larry Schwankl
UC Cooperative Extension
(559) 646-6569
ljschwankl@ucanr.edu

Irrigating Efficiently

- **Only apply the water needed to grow the crop.**

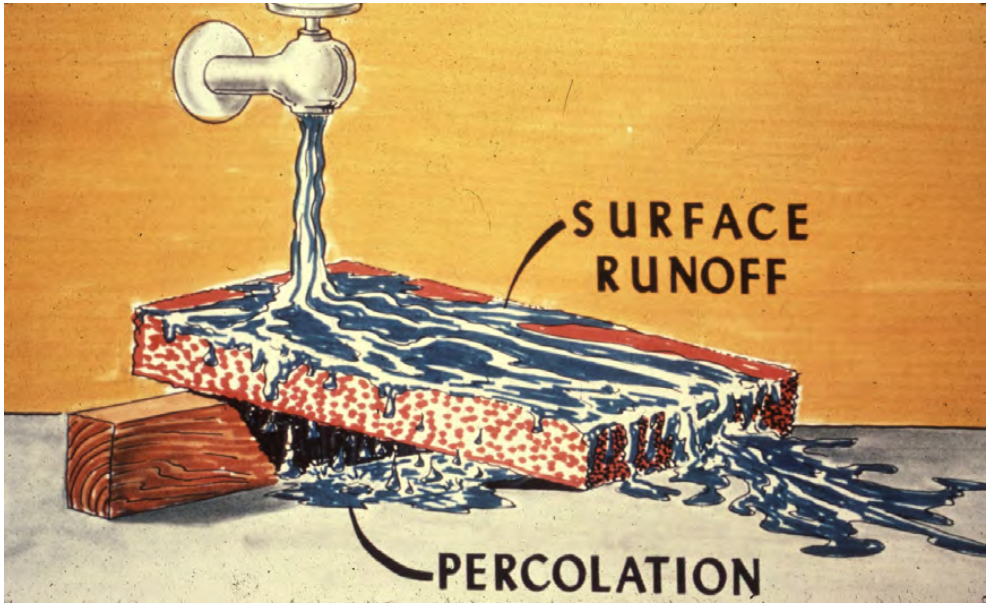
Irrigation Efficiency

- Measure of how much of the applied water goes to "reasonable and beneficial uses".
  - The major beneficial use is to supply plant water needs (ET).



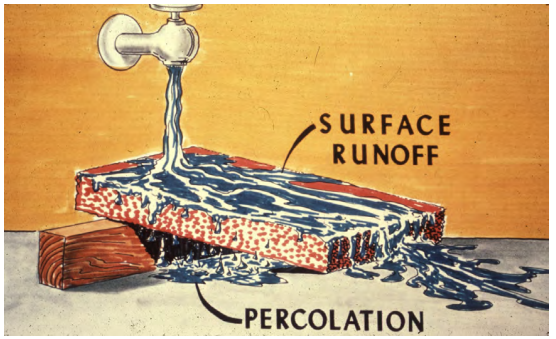
Irrigation Efficiency

- Measure of how much of the applied water goes to "reasonable and beneficial uses".
  - The major beneficial use is to supply plant water needs (ET).
  - **Other beneficial uses can be frost protection, salt leaching, etc.**



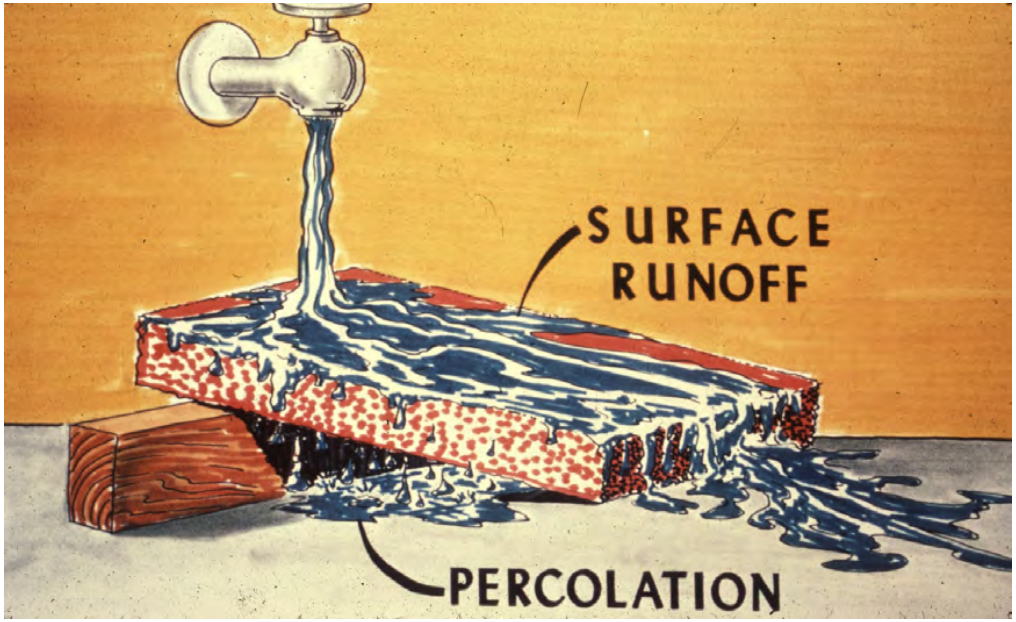
Irrigation Efficiency

- Measure of how much of the applied water goes to "reasonable and beneficial uses".
  - The major beneficial use is to supply plant water needs (ET) and grow productive crops.
  - Other beneficial uses can be frost protection, salt leaching, etc
  - **Non-beneficial uses or losses are:**
  - **Deep percolation below root zone except the amount needed to manage salinity**
  - **Tailwater runoff that is not reused**



Irrigation Efficiency

$$\text{Irrigation Efficiency (\%)} = \frac{\text{Benefically} - \text{used Water}}{\text{Total Water Applied}} \text{ x } 100$$

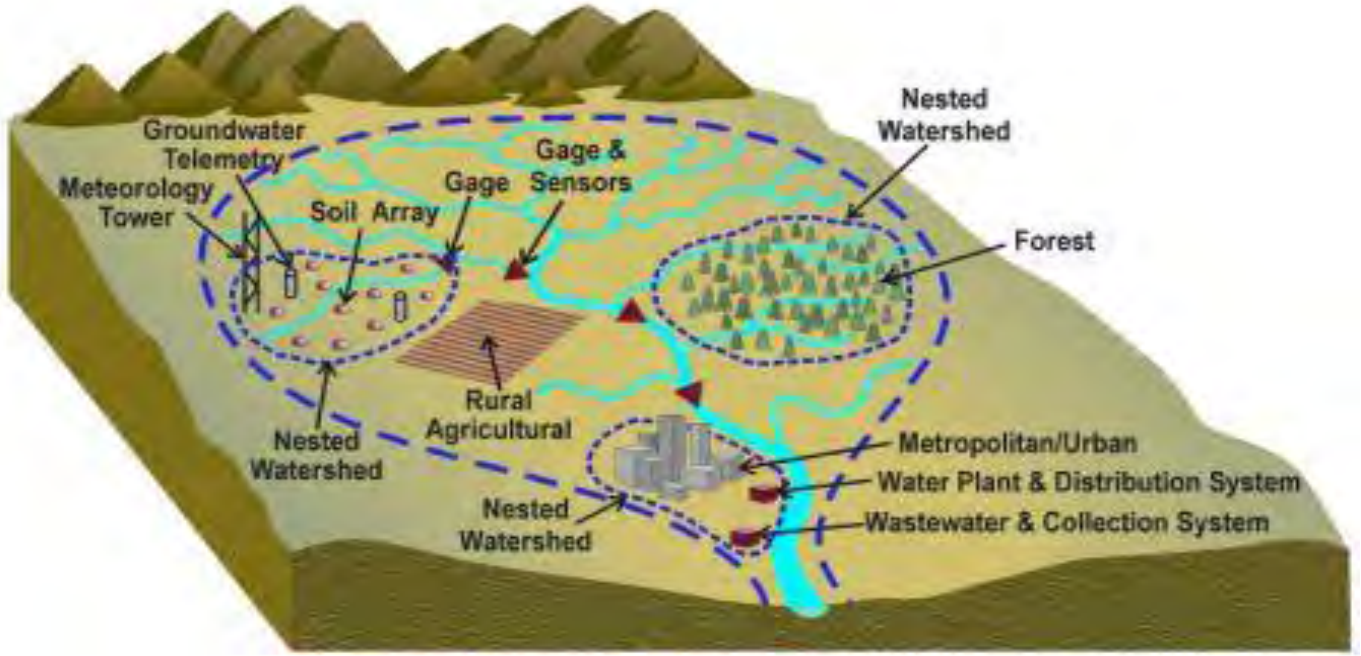


Irrigation Efficiency

Different people arrive at different estimates for Irrigation Efficiency. Why?

Field scale – vs – Watershed or basin scale

Single irrigation – vs – Sum of several irrigations in a season



Irrigating Efficiently

- **So, how do we do it?**

Irrigating Efficiently

- So, how do we do it?
  - **Know how much water to apply.**

$$\text{Tree Water Use (gal/day)} = \text{Tree Spacing } (ft^2) \times \text{Tree ET (in/day)} \times 0.623$$

Irrigating Efficiently

- So, how do we do it?
  - Know how much water to apply.
  - **Apply the water with a quality irrigation system.**

Irrigation Uniformity

- **When we irrigate, no matter what strategy you use, you want the entire orchard to benefit from that strategy.**

Irrigation Uniformity

- When we irrigate, no matter what strategy you use, you want the entire orchard to benefit from that strategy.
    - **That means that each tree in the block gets treated the same. That is Uniform Irrigation.**

Irrigation Uniformity

- When we irrigate, no matter what strategy you use, you want the entire orchard to benefit from that strategy.
  - That means that each tree in the block gets treated the same. That is Uniform Irrigation.
  - **With Non-Uniform Irrigation, some trees get more water and some trees get less.**

Irrigation Uniformity

- When we irrigate, no matter what strategy you use, you want the entire orchard to benefit from that strategy.
    - That means that each tree in the block gets treated the same. That is Uniform Irrigation.
    - With Non-Uniform Irrigation, some trees get more water and some trees get less.
    - **We usually want to make sure all the trees get enough water, so with a non-uniform system we end up over-irrigating some of the trees.**

Irrigation Efficiency

- **Bottom Line:**
  - **You need a uniform irrigation system to be an efficient irrigator.**

Irrigation Efficiency

- **Bottom Line:**
  - **You need a uniform irrigation system to be an efficient irrigator.**
  - **And you need to manage it well!**

Evaluating Microirrigation Systems

- **Do you have uniform application of water?**

Evaluating Microirrigation Systems

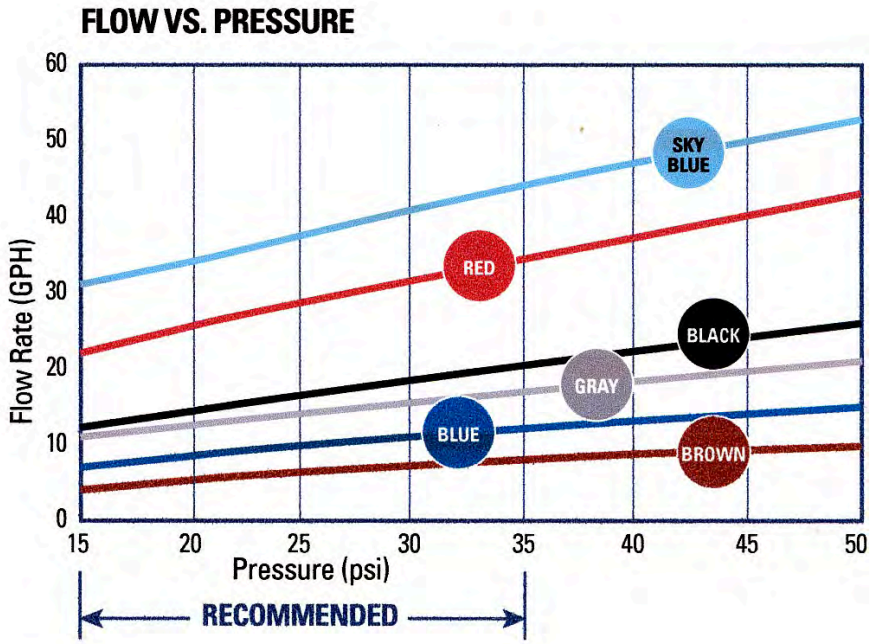
- Do you have uniform application of water?
  - **With a microirrigation system, you should have.**

Evaluating Microirrigation Systems

- **Do you have Uniform application of water?**
- **Why wouldn't you?**
  - **Not a good irrigation system design.**

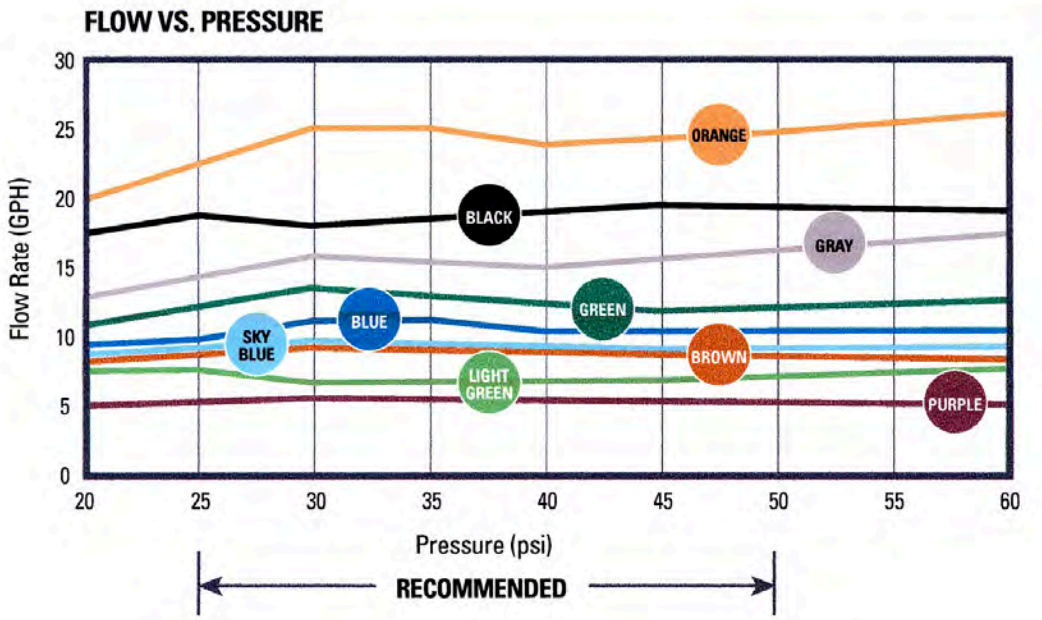
Evaluating Microirrigation Systems

- Do you have Uniform application of water?
- **Why wouldn't you?**
  - Not a good irrigation system design.
    - **Pressure differences in the system lead to different application rates.**



Evaluating Microirrigation Systems

- Do you have Uniform application of water?
- **Why wouldn't you?**
  - Not a good irrigation system design.
    - Pressure differences in the system lead to different application rates.
      - **Pressure-compensating (PC) microsprinklers are an exception.**



Evaluating Microirrigation Systems

- Do you have Uniform application of water?
- **Why wouldn't you?**
  - Not a good irrigation system design.
    - Pressure differences in the system lead to different application rates.
    - **Pressure differences come from elevation differences and from pressure losses due to frictional losses as water moves through pipes & tubing.**

Evaluating Microirrigation Systems

- Do you have Uniform application of water?
- **Why wouldn't you?**
  - Not a good irrigation system design.
  - **Maintenance problems.**
    - **Clogging problems can lead to serious non-uniformity problems. Almost all clogging problems can be solved or prevented.**

Evaluating Microirrigation Systems

- **How do you determine your irrigation uniformity?**

Evaluating Microirrigation Systems

- How do you determine your irrigation uniformity?
  - **Only way to really determine it is to measure it in the field!**
    - **Orchard microsprinklers are one of the easiest to measure.**

Evaluating Microirrigation Systems

- How do you determine your irrigation uniformity?
  - Only way to really determine it is to measure it in the field!
  - **What can you measure?**

Evaluating Microirrigation Systems

- How do you determine your irrigation uniformity?
  - Only way to really determine it is to measure it in the field!
  - What can you measure?
    - **Pressure.**
      - **Where? Head of lateral lines, tail end of laterals lines, can measure along the lateral lines.**
      - **Write them down, on a layout of the block is best.**

Evaluating Microirrigation Systems

- How do you determine your irrigation uniformity?
  - Only way to really determine it is to measure it in the field!
  - What can you measure?
    - **Pressure.**
      - **Big pressure differences, greater than 20%, often indicates uniformity problems.**

Evaluating Microirrigation Systems

- How do you determine your irrigation uniformity?
  - Only way to really determine it is to measure it in the field!
  - What can you measure?
    - **Pressure.**
      - Big pressure differences, greater than 20%, often indicates uniformity problems.
      - **Unfortunately, pressure measurements don't tell us much about clogging problems. To detect clogging problems, we need to measure emitter discharges.**

Evaluating Microirrigation Systems

- How do you determine your irrigation uniformity?
  - Only way to really determine it is to measure it in the field!
  - What can you measure?
    - Pressure.
    - **Emitter discharge.**
      - **Take them where you take pressure measurements, plus other locations.**
      - **Keep track of where you take them.**

Evaluating Microirrigation Systems

- How do you determine your irrigation uniformity?
  - Only way to really determine it is to measure it in the field!
  - What can you measure?
    - Pressure.
    - **Emitter discharge.**
      - Take them where you take pressure measurements, plus other locations.
      - Keep track of where you take them.
      - **How to do it. Collect discharge for 30 seconds.**

ml of Water Collected in 30 seconds	x	0.0317	=	Discharge Rate (gallons per hour)

Evaluating Microirrigation Systems

- How do you determine your irrigation uniformity?
  - Only way to really determine it is to measure it in the field!
  - What can you measure?
    - Pressure.
    - **Emitter discharge.**
      - Take them where you take pressure measurements, plus other locations.
      - Keep track of where you take them.
      - How to do it.
      - **If they vary by more than 10%, you need to figure out why.**

        If emitter variability can't be explained by pressure differences, then you likely have clogging issues.

Evaluating Microirrigation Systems

- How do you determine your irrigation uniformity?
  - Only way to really determine it is to measure it in the field!
  - What can you measure?
    - Pressure.
    - **Emitter discharge.**
      - Take them where you take pressure measurements, plus other locations.
      - Keep track of where you take them.
      - How to do it.
      - If they vary by more than 10%, you need to figure out why.

        If emitter variability can't be explained by pressure differences, then you likely have clogging issues.
      - **Gives you a measurement of uniformity (Distribution Uniformity) and an average application rate.**

Evaluating Microirrigation Systems

- How do you determine your irrigation uniformity?
  - Only way to really determine it is to measure it in the field!
  - What can you measure?
    - Pressure.
    - **Emitter discharge.**
      - **Lateral line flow meters can also be a good tool. Tracks changes across time.**

Evaluating Microirrigation Systems

- How do you determine your irrigation uniformity?
  - Only way to really determine it is to measure it in the field!
  - What can you measure?
    - Pressure.
    - Emitter discharge.

    - **Step-by-step procedure available.**

http://micromaintain.ucanr.edu

SKIP TO CONTENT SITE MAP Enter Search Terms

University of California and W-2128

Maintenance of Microirrigation Systems

http://micromaintain.ucanr.edu

PRINT

Maintenance of Microirrigation Systems

Predicting Clogging Problems

"What should I watch for?"

Solutions to Existing Clogging Problems

"I Have a Clogging Problem and I Want to Solve It"

System evaluation for emission device clogging

"How do I determine if I have a clogging problem?"

Routine Maintenance Tasks

"What should I do to keep my microirrigation system running well?"

Microirrigation systems include microsprinklers for tree crops, drip emitters for trees, vines, and some row crops, and drip tape for row and field crops. Microirrigation systems apply water to the soil through emitters that are installed along drip lines and contain very small flow passages. Microirrigation systems can apply water and fertilizers more uniformly than other irrigation methods. This uniformity results in potentially higher yields, higher revenue, and reduced irrigation operating costs.

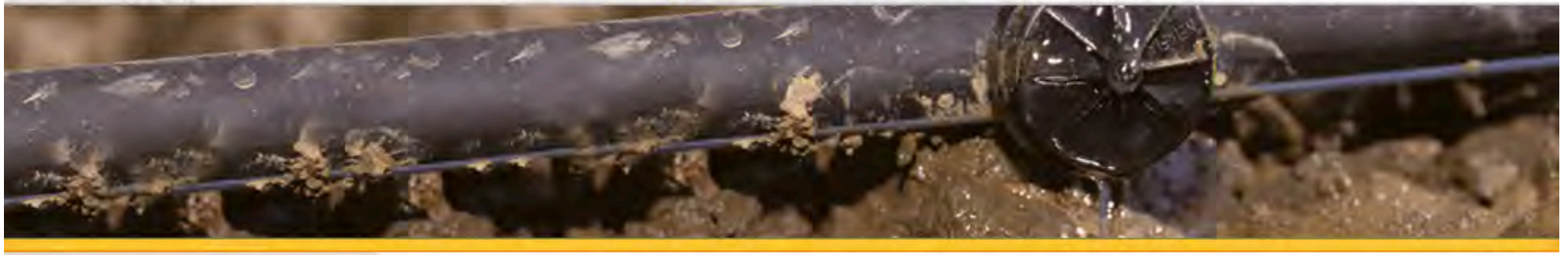
Uniformity, a performance characteristic of irrigation systems, is a measure of the evenness of the applied water throughout the irrigation system. Distribution uniformity (DU), sometimes called emission uniformity (EU), is an index that describes how evenly or uniformly water is applied throughout the field. A uniformity of 100% means the same amount of water was applied everywhere. Unfortunately, all irrigation systems apply water at a uniformity of less than 100%, and thus some parts of a field receive more water than others. Field evaluations have shown that microirrigation systems have the potential for higher uniformity than other irrigation methods. However, clogging reduces the uniformity of applied water in microirrigation systems, thus increasing the relative differences in applied water throughout a field.

The small flow passages in the emitters and microsprinklers make microirrigation systems highly susceptible to clogging. Clogging reduces the uniformity of the applied water and decreases the amount of applied water. Clogging also decreases the amount of salt leaching around the lateral line in saline soils.

SKIP TO CONTENT SITE MAP Enter Search Terms

University of California and W-2128

Maintenance of Microirrigation Systems



PRINT

System evaluation for emission device clogging

How do I determine if I have a clogging problem?

There are two methods that are frequently used to detect microirrigation system clogging. Either (1) you measure the system flow rate, or (2) you collect samples from the emission devices.

In some locations, you may be able to get a professional irrigation system evaluation. This service may be offered by a private consultant or a mobile irrigation evaluation team (mobile lab), sponsored by a local irrigation district or by a state or federal agency. Mobile labs are often subsidized by their sponsors so they may charge only a minimal amount for an irrigation evaluation.

Another practical alternative is for a grower to conduct his or her own irrigation evaluation. This self-evaluation usually is not as extensive as a professional evaluation but it can provide important information on clogging problems.

Click below for information on:

Professional evaluation

Self-evaluation

http://micromaintain.ucanr.edu

SKIP TO CONTENT SITE MAP Enter Search Terms

University of California and W-2128

Maintenance of Microirrigation Systems

PRINT

Self-evaluation

Self-evaluation of microirrigation systems

With a little guidance and motivation, it is not difficult to do an evaluation of your own microirrigation system. While a professional evaluation will be more thorough and provide more information, self-evaluation is cheaper and it can provide you with useful information such as the average emitter discharge rate and a measure of emitter discharge variability.

Click on a type of microirrigation system below for more information on how to evaluate that system.

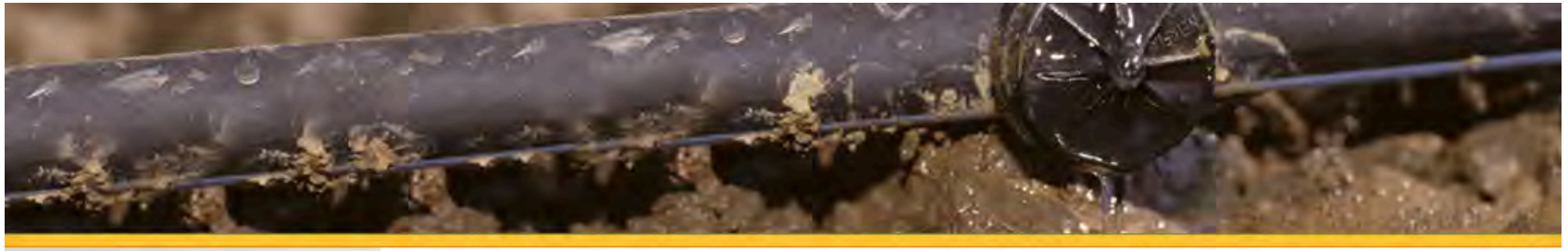
Surface drip tubing

Microsprinklers

Surface drip tape

Subsurface drip tapes and tubing

http://micromaintain.ucanr.edu



PRINT

Microsprinklers

http://micromaintain.ucanr.edu

Field Evaluation of Microsprinkler Systems

In evaluating a microsprinkler system, there are two main items of interest: (1) the average discharge rate for the microsprinklers, and (2) the variability of microsprinkler discharge rates. Luckily, collecting a single set of field data can help you determine values for both items.

Microsprinkler irrigation in a walnut orchard. Photo: L. Schwankl.

Two ways to determine whether a microirrigation system is experiencing clogging problems are (1) either install a flow meter on the system as a whole or install a smaller flow meter on several lateral lines and (2) collect discharge from a sample of microsprinklers from throughout the microirrigation system.

Flow meters

An advantage to using a single flow meter at the head of the microirrigation system is that it collects information over a period of time. A disadvantage is that even if the flow meter can help detect a problem such as clogging (by indicating a decrease in flow rate over time), a single flow meter gives you no information about where in where in the system you are likely to find (and remedy) the clogging.

Flow meters on lateral lines are better able to detect clogging than a single, large flow meter at the head of the system and they cost $100 or less each. You will need to install multiple lateral line flow meters throughout the system in order to get an accurate picture of what is happening.

Microsprinkler discharge measurements

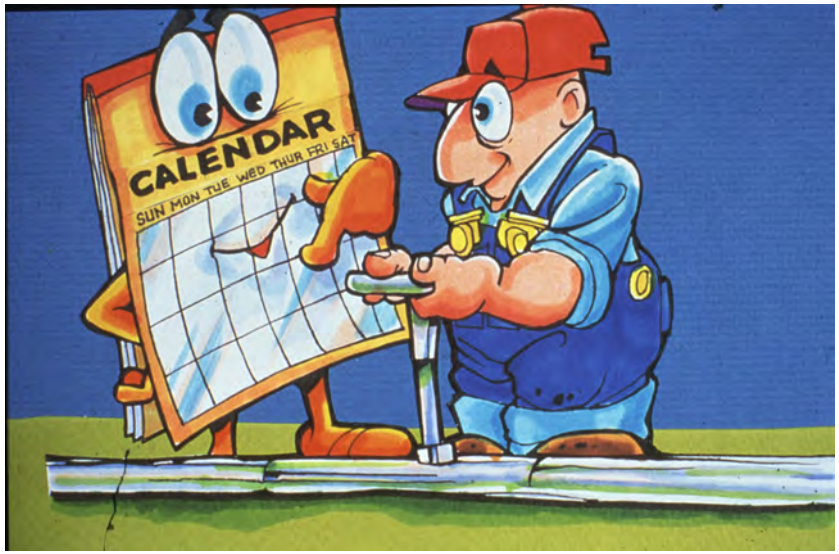
When you collect and measure the water discharged from a sample of microsprinklers in your system, you

Summary: Irrigating Efficiently

- **Once you have your irrigation system in shape and know its' application rate, then it's time for attention to detail.**

Summary: Irrigating Efficiently

- Once you have your irrigation system in shape and know its' application rate, then it's time for attention to detail.
  - **Match the irrigation to the tree water needs, check to make sure you did OK, then do it again. And again, through the whole season.**



Questions???

Larry Schwankl

559-646-6569 ljschwankl@ucanr.edu

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

Maintenance website: http://micromaintain.ucanr.edu