Microirrigation System Efficiency

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Microirrigation Systems

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- Applying the right amount of water at the right time – Irrigation Scheduling.
Microirrigation Systems

To be energy efficient with a microirrigation system, (drip, microsprinklers, etc.) means being water efficient.

- Applying the right amount of water at the right time – Irrigation Scheduling.
- Applying the water uniformly – all emitters discharge nearly the same amount of water.
Irrigation Scheduling

- Monitor the weather.

ET = Evapotranspiration Scheduling

Historical or Real-time
Irrigation Scheduling

- Monitor the weather.
- Monitor the soil.
Irrigation Scheduling

- Monitor the weather.
- Monitor the soil.
- Monitor the plant.
Irrigation Scheduling

- Monitor the weather.
- Monitor the soil.
- Monitor the plant.

- **Good approach for microirrigation:**
  - ET scheduling backed up with soil and/or plant monitoring.
Irrigation Scheduling

ET information = in/day, in/wk, etc.

and

Permanent crop drip: emitter discharge in gal/hr.

\[
\text{Plant Water Use (gal/day)} = \frac{\text{ET (in/day)}}{\text{(ft}^2)} \times 0.623
\]
Irrigation Scheduling

ET information = in/day, in/wk, etc.

and

Row crop drip: discharge in gpm/100 ft.
Microirrigation Systems – Uniformity

Why would there be non-uniformity?
1. Manufacturing variation - minor with good microirrigation products.
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Can minimize pressure differences with good design
Microirrigation Systems – Uniformity

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1. Manufacturing variation - minor with good microirrigation products.
2. Pressure differences - due to elevation changes and pressure losses.
3. Clogging problems.
Microirrigation Systems - Clogging

Good system

Figure 2. Distribution of emitter discharge rates along a well-maintained drip line using surface water for irrigation. Chlorination was used to control biological growths. The decrease in discharge rate was due to pressure variation normally experienced in drip lines. An EU of 88% is considered to be good. The discharge rates of two adjacent emitters (emitter 1 and emitter 2) were determined at each measurement location along the lateral.
Microirrigation Systems - Clogging

Biological Clogging

Figure 3. Biological growths greatly reduced emitter discharge rates and uniformity along a 6-month-old drip line using surface water for irrigation. The water was filtered, but not chlorinated. The design emitter discharge rate was about 0.20 gph. The discharge rates of two adjacent emitters (emitter 1 and emitter 2) were determined at each measurement location along the lateral.
Microirrigation Systems - Clogging

Chemical Precipitate Clogging

Figure 4. Iron and calcium carbonate precipitation greatly reduced emitter discharge uniformity along the drip line. The design emitter discharge rate was 0.5 gph. The discharge rates of two adjacent emitters (emitter 1 and emitter 2) were determined at each measurement location along the lateral.
Microirrigation Systems - Clogging

No Line Flushing

Figure 5. Little or no flushing completely clogged emitters near the end of the drip line (gaps in the data near the end of the drip line) of a 2-year-old lateral. The discharge rates of two adjacent emitters (emitter 1 and emitter 2) were determined at each measurement location along the lateral. An excessive drip line length contributed to the large change in emitter discharge rates.
Emitters:

Clogging is the greatest “threat” to emitters.
Clogging of Microirrigation Systems

Source: Physical Clogging - Particulates
Clogging of Microirrigation Systems

Source: Physical Clogging - Particulates

Solution: Filtration
Filters:

- Screen, disk, and sand media filters are all available.

- They can all filter to the same degree
  BUT
  they req. different frequency of cleaning.
Mesh size recommended by emitter manufacturer
Screen Filters
Screen Filters

- The degree of filtration is measured by mesh size

<table>
<thead>
<tr>
<th>Soil Particle</th>
<th>Particle Diam (mm)</th>
<th>Mesh Size</th>
<th>Mesh Opening Size (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very coarse sand</td>
<td>1 - 2</td>
<td>20</td>
<td>0.711</td>
</tr>
<tr>
<td>Coarse sand</td>
<td>0.5 - 1</td>
<td>40</td>
<td>0.420</td>
</tr>
<tr>
<td>Medium sand</td>
<td>0.25 - 0.5</td>
<td>100</td>
<td>0.152</td>
</tr>
<tr>
<td>Fine sand</td>
<td>0.1 - 0.25</td>
<td>200</td>
<td>0.074</td>
</tr>
<tr>
<td>Very fine sand</td>
<td>0.05 - 0.10</td>
<td>320</td>
<td>0.044</td>
</tr>
<tr>
<td>Silt</td>
<td>0.002 - 0.05</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clay</td>
<td>&lt; 0.002</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Also rated by mesh size

Disk Filters
# Sand Media Filters

<table>
<thead>
<tr>
<th>Media Designation Number</th>
<th>Material</th>
<th>Mean Effective Sand Size</th>
<th>Filtration Quality</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>(mm)</td>
<td>(in.)</td>
</tr>
<tr>
<td>8</td>
<td>crushed granite</td>
<td>1.50</td>
<td>0.059</td>
</tr>
<tr>
<td>11</td>
<td>crushed granite</td>
<td>0.78</td>
<td>0.031</td>
</tr>
<tr>
<td>16</td>
<td>crushed silica</td>
<td>0.66</td>
<td>0.026</td>
</tr>
<tr>
<td>20</td>
<td>crushed silica</td>
<td>0.46</td>
<td>0.018</td>
</tr>
<tr>
<td>30</td>
<td>crushed silica</td>
<td>0.34</td>
<td>0.013</td>
</tr>
</tbody>
</table>
Clogging of Microirrigation Systems

Source: Chemical Precipitates

- Lime (calcium carbonate) and iron are the most common problems.
Chemical Precipitate Clogging of Microirrigation Systems

Water quality levels of concern:

- Calcium: pH > 7.5 and 2.0 meq/l (120 ppm) of bicarbonate

- Iron: pH > 4.0 and 0.5 ppm iron
  - Special water sample reqd.
Clogging of Microirrigation Systems

Source: Lime

Solution: pH Control (Acidification) + filtration
Dealing with Iron Precipitation:

1. Precipitate iron in a pond / reservoir
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1. Precipitate iron in a pond / reservoir

2. Chemicals (e.g. phosphonic acid, phosphonate) may keep iron in solution
   - Maintenance, not clean-up products
Clogging of Microirrigation Systems

Source: Biological Sources
Clogging of Microirrigation Systems

Source: Biological Sources

Solution: Filtration (usually media filters) + Biocide
Biological Clogging

Acid may deter but not eliminate biocide chlorine copper
Chlorine

- **Sources:**
  - Liquid - sodium hypochlorite.
  - Solid - calcium hypochlorite.
  - Gas chlorine.
Chlorine:

- **Sources:**
  - Liquid - sodium hypochlorite.
  - Solid - calcium hypochlorite.
  - Gas chlorine.

- **When add chlorine source to water:**
  - Forms hypochlorous acid + hypochlorite.
  - Hypochlorous acid is more powerful biocide.
  - If pH is lower (acidic), more hypochlorous acid is present - better biocide.
pH Effect on Hypochlorous Acid Concentration

Hypochlorous Acid Concentration (%)

pH

4  5  6  7  8  9  10
Chlorine as a Biocide:

Free Chlorine

Continual Injection  1-2 ppm
Periodic Injection   10-20 ppm

Contact time is important – inject for at least a few hours. Longer is better.

Test for chlorine using a pool / spa test kit
Chlorine: Injection Rates

- Sodium hypochlorite (liquid)
  - Example: household bleach w/ 5.25% active chlorine.

\[
\text{Chlorine injection} = \text{System flow} \times \text{Desired Cl} \times 0.006 \div \text{Strength of Conc. (ppm)} \times \text{Cl soln (%)}
\]

- Calcium hypochlorite (solid)
  - 65-70% available chlorine.
  - 12.8 lbs. of calcium hypochlorite added to 100 gallons of water forms a 1% solution.
  - Use above formula.
flushing of microirrigation systems:

- Silts and clay particles pass through even the best filters.
Flushing

- Silts and clay particles pass through even the best filters.

- Need to flush the system - mainlines, submains, and laterals (in that order).
Flush laterals by hand or use automatic flushing end caps.
Questions?

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