Irrigation Systems and Their Maintenance

Larry Schwankl, Irrigation Specialist

559-646-6569   e-mail: schwankl@uckac.edu

Presentation will be at:  http://schwankl.uckac.edu
Irrigation Systems:

- Sprinkler Systems.
- Drip Systems.
Sprinkler Irrigation Systems:
Sprinkler Irrigation Systems:

- Can be used for frost protection and/or irrigation.
Frost Protection with Sprinklers:

- Significantly affects the design (and cost) of a sprinkler system.
- 35 - 50 gpm/acre recommended.
Irrigating with Sprinklers:

- To do good irrigation scheduling, you need to know how much water you are applying.
Irrigating with Sprinklers:

- To do good irrigation scheduling, you need to know how much water you are applying.
  - You need to know the application rate (in/hr) of the sprinkler system.
How to determine sprinkler irrigation application rates:

96.3 \times (\text{sprinkler discharge} - \text{gpm})

\text{Application} = \frac{96.3 \times (\text{sprinkler discharge} - \text{gpm})}{\text{Dist. between sprinklers along row (ft)} \times \text{sprinklers in row (ft)} \times \text{Distance between row (ft)}}

\text{Rate (in/hr)}

\text{Need to know the sprinkler discharge (gpm)}
How to measure sprinkler irrigation application rates:

Sprinkler Discharge (gallons per minute - gpm) for various nozzle sizes (inches) and pressures (psi).

<table>
<thead>
<tr>
<th>psi</th>
<th>3/32</th>
<th>7/64</th>
<th>1/8</th>
<th>9/64</th>
<th>5/32</th>
<th>11/64</th>
<th>3/16</th>
<th>13/64</th>
<th>7/32</th>
<th>15/64</th>
<th>1/4</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>1.17</td>
<td>1.60</td>
<td>2.09</td>
<td>2.65</td>
<td>3.26</td>
<td>3.92</td>
<td>4.69</td>
<td>5.51</td>
<td>6.37</td>
<td>7.32</td>
<td>8.34</td>
</tr>
<tr>
<td>25</td>
<td>1.31</td>
<td>1.78</td>
<td>2.34</td>
<td>2.96</td>
<td>3.64</td>
<td>4.38</td>
<td>5.25</td>
<td>6.16</td>
<td>7.13</td>
<td>8.19</td>
<td>9.32</td>
</tr>
<tr>
<td>30</td>
<td>1.44</td>
<td>1.95</td>
<td>2.56</td>
<td>3.26</td>
<td>4.01</td>
<td>4.83</td>
<td>5.75</td>
<td>6.80</td>
<td>7.86</td>
<td>8.97</td>
<td>10.21</td>
</tr>
<tr>
<td>35</td>
<td>1.55</td>
<td>2.11</td>
<td>2.77</td>
<td>3.50</td>
<td>4.31</td>
<td>5.18</td>
<td>6.21</td>
<td>7.30</td>
<td>8.43</td>
<td>9.69</td>
<td>11.03</td>
</tr>
<tr>
<td>40</td>
<td>1.66</td>
<td>2.26</td>
<td>2.96</td>
<td>3.74</td>
<td>4.61</td>
<td>5.54</td>
<td>6.64</td>
<td>7.80</td>
<td>9.02</td>
<td>10.35</td>
<td>11.79</td>
</tr>
<tr>
<td>45</td>
<td>1.76</td>
<td>2.39</td>
<td>3.13</td>
<td>3.99</td>
<td>4.91</td>
<td>5.91</td>
<td>7.03</td>
<td>8.30</td>
<td>9.60</td>
<td>10.99</td>
<td>12.50</td>
</tr>
<tr>
<td>50</td>
<td>1.85</td>
<td>2.52</td>
<td>3.30</td>
<td>4.18</td>
<td>5.15</td>
<td>6.19</td>
<td>7.41</td>
<td>8.71</td>
<td>10.10</td>
<td>11.58</td>
<td>13.18</td>
</tr>
<tr>
<td>55</td>
<td>1.94</td>
<td>2.64</td>
<td>3.46</td>
<td>4.37</td>
<td>5.39</td>
<td>6.48</td>
<td>7.77</td>
<td>9.12</td>
<td>10.50</td>
<td>12.15</td>
<td>13.82</td>
</tr>
<tr>
<td>60</td>
<td>2.03</td>
<td>2.76</td>
<td>3.62</td>
<td>4.50</td>
<td>5.65</td>
<td>6.80</td>
<td>8.12</td>
<td>9.56</td>
<td>11.05</td>
<td>12.68</td>
<td>14.44</td>
</tr>
<tr>
<td>65</td>
<td>2.11</td>
<td>2.88</td>
<td>3.77</td>
<td>4.76</td>
<td>5.87</td>
<td>7.06</td>
<td>8.45</td>
<td>9.92</td>
<td>11.45</td>
<td>13.21</td>
<td>15.03</td>
</tr>
<tr>
<td>70</td>
<td>2.19</td>
<td>2.99</td>
<td>3.91</td>
<td>4.96</td>
<td>6.10</td>
<td>7.34</td>
<td>8.78</td>
<td>10.32</td>
<td>11.95</td>
<td>13.70</td>
<td>15.59</td>
</tr>
<tr>
<td>75</td>
<td>2.27</td>
<td>3.09</td>
<td>4.05</td>
<td>5.12</td>
<td>6.30</td>
<td>7.58</td>
<td>9.08</td>
<td>10.66</td>
<td>12.32</td>
<td>14.19</td>
<td>16.14</td>
</tr>
</tbody>
</table>
Measuring pressure at a sprinkler using a pitot tube:
Measuring the discharge rate of a sprinkler nozzle:
How to determine sprinkler irrigation application rates:

\[
\text{Application Rate (in/hr)} = \frac{96.3 \times (\text{sprinkler discharge} - \text{gpm})}{\text{Distance between sprinklers along row (ft)} \times \text{Distance between sprinklers in row (ft)} \times \text{Dist. between rows (ft)}}
\]
# Irrigation

## Sprinklers vs. Drip

<table>
<thead>
<tr>
<th>Sprinklers</th>
<th>Drip</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frost &amp; irrigation</td>
<td>Saves water (often)</td>
</tr>
<tr>
<td>Supports cover crop</td>
<td>Fewer weeds</td>
</tr>
<tr>
<td>Applies water faster</td>
<td>Good soil moisture</td>
</tr>
<tr>
<td>Low maintenance</td>
<td>growing conditions</td>
</tr>
<tr>
<td></td>
<td>Maintenance reqs.</td>
</tr>
</tbody>
</table>
Combined sprinkler & drip systems

Sprinklers for frost protection and drip for irrigation.

- Often an electric motor is used for drip irrigation and diesel or natural gas is used for sprinklers (frost protection).

- Reservoir may be needed for frost protection water supply.
Drip Irrigation Systems:

Gives you the most control over your irrigation - IMPORTANT!
Drip Irrigation

How much water are you applying?

Application rate:

- Vine water use given in inches/day
- Emitter discharge in gallons/hr
Convert vine water use (in/day to gal/day):

\[
\text{Water use by the vine} = \text{spacing} \times \text{use} \times 0.623
\]

\begin{align*}
\text{(gal/day)} & \quad \text{(ft}^2\text{)} & \quad \text{(in/day)} \\
\end{align*}

Example: Vine spacing = 6 ft. x 9 ft. = 54 ft\(^2\)
Vine water use = 0.2 in./day

Water use by:
the vine \quad = 54 \text{ ft}^2 \times 0.2 \text{ in/day} \times 0.623
(gal/day) \quad = 6.7 \text{ gal/day}
Drip Irrigation Systems:

- Gives you the most control over your irrigation.

- Can be very uniform depending on the design.
Drip Irrigation Systems:

What should you look for in a good design?
Emitters:

- Usually 0.5 or 1 gph emitters used.
- 1 or 2 emitters per vine is common
  - e.g. two 0.5 gph emitters per vine.
Emitters:

“Punch-in”, in-line, or “built-in” emitters all available - all good.
Emitters:

- Pressure-compensating emitters are available.
  - Particularly good where you have significant elevation changes.

2.31 ft. of elevation change = 1 psi
“Regular” emitter
Lateral lines:

- Polyethylene lines.
- Desire for high irrig. uniformity limits the length of the lateral lines.
  - Minimize pressure differences.
Lateral lines:

- Desire for high irrig. uniformity limits the length of the lateral lines.

- Length of lateral dependent on tubing flow rate (emitter discharge, emitter spacing) and tubing diameter.
**Lateral lines:**

- Desire for high irrig. uniformity limits the length of the lateral lines.
- Pressure-compensating (PC) emitters may allow longer laterals.
Mainline and Submain Pipelines:

- PVC pipe.

- Irrig. system design is important:
  - Pipe should be large enough to minimize pressure losses, but you also want to keep the initial pipe cost down.
800 hp
Pump:

- Sized to deliver the flow rate & pressure reqd. at the farthest lateral.

- Plus reqs. such as filter cleaning.
Filters:

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

- They all filter to the same degree

  BUT

  they req. different frequency of cleaning.
Screen Filters
Disk Filter
Injectors:

Inject chemicals, fertilizers, gypsum, etc.
Injectors:

- Different injectors may be reqd. for various uses.
  - Chemicals such as chlorine may req. a small injector (e.g. < 15 gph).
  - Fertilizers may req. a small pump (e.g. small gpm).
  - Gypsum, dry chemicals, etc. may require a solutionizer machine.
Venturi Injector

- Venturi injector
- Check valve
- Metering valve
Flow meter:

Important for both irrigation scheduling and for maintenance.
Pressure regulator:

- Maintains pressure at desired level.
- Particularly important where have significant elevation changes.

2.31 ft. of elev. change = 1 psi
Maintenance of drip systems:
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
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
Clogging of Microirrigation Systems

Source: Lime

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

1. Precipitate iron in a pond / reservoir

2. Chemicals (e.g. phosphonic acid, phosphonate) may keep iron in solution
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 as a Biocide

<table>
<thead>
<tr>
<th>Action</th>
<th>Free Chlorine</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prevent growth</td>
<td>1 - 2 ppm</td>
</tr>
<tr>
<td>Periodic injection</td>
<td>10 - 20</td>
</tr>
<tr>
<td>Super chlorination</td>
<td>500 - 1000</td>
</tr>
<tr>
<td>(reclamation)</td>
<td></td>
</tr>
</tbody>
</table>

Test for chlorine using a pool / spa test kit
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).
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.
<table>
<thead>
<tr>
<th>Water use by the vine</th>
<th>Vine spacing</th>
<th>Vine use</th>
<th>Vine water (gal/day) x 0.623 (in/day)</th>
</tr>
</thead>
</table>

Questions?
Larry Schwankl
559-646-6569 schwankl@uckac.edu
http://schwankl.uckac.edu

UC Publications: http://anrcatalog.ucdavis.edu
Microirrigation of Trees and Vines = Pub. 3378
Maintaining Microirrigation Systems = Pub. 21637