Rust Never Sleeps
Ways to deal with iron in drip irrigation water
WA berry irrigation systems

Non-uniformity primarily emitter plugging

Observed or probable iron bacteria present
Iron Bacteria

- Common in nature (extreme example on right).
- “Feed” on soluble (ferrous) iron in well water.
Iron Bacteria

- Excrete insoluble (ferric) iron and slime.
- Can plug emitters when soluble iron levels are as low as 0.1 ppm
**Drip Water Quality guidelines**
*(from Kansas State extension bulletin MF-2178)*

### Table 1. Criteria for Plugging Potential of Drip Irrigation System Water Sources

<table>
<thead>
<tr>
<th>Factor</th>
<th>Slight</th>
<th>Moderate</th>
<th>Severe</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Physical</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Suspended Solids</td>
<td>&lt;50</td>
<td>50–100</td>
<td>&gt;100</td>
</tr>
<tr>
<td>(filterable)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Chemical</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>pH</td>
<td>&lt;7.0</td>
<td>7.0–7.5</td>
<td>&gt;7.5</td>
</tr>
<tr>
<td>Manganese</td>
<td>&lt;0.1</td>
<td>0.1–1.5</td>
<td>&gt;1.5</td>
</tr>
<tr>
<td>Iron</td>
<td>&lt;0.1</td>
<td>0.1–1.5</td>
<td>&gt;1.5</td>
</tr>
<tr>
<td>Hardness</td>
<td>&lt;150</td>
<td>150–300</td>
<td>&gt;300</td>
</tr>
<tr>
<td>Hydrogen sulfide</td>
<td>&lt;0.5</td>
<td>0.5–2.0</td>
<td>&gt;2.0</td>
</tr>
</tbody>
</table>

*Plugging Hazard [in parts per million (ppm)* except pH]*

*Some water reports list results as milligrams per liter, mg/L, which is equal to parts per million, ppm*
Testing for Iron (DIY)

• **Ferrous** Iron test, sometimes called **Dissolved** iron test: reacts with soluble (ferrous) iron to form a colored compound. More iron=more color

• **Total** Iron test: first acidifies the water to make all the iron soluble, then undergoes a similar reaction to the one above.

Both types of test are available from Hach (www.hach.com)
Testing for Iron (outside labs)

- **Local labs** for iron testing (that I know of):
  - Wm. F. Black Soil testing & Analysis: 360-757-6112
  - Edge Analytical: 360-757-1400
  - Exact Scientific Services: 360-733-1205

- For a more **complete list** of labs in the Pacific Northwest, see EB1578E “Analytical Laboratories and Consultants serving Agriculture in the Pacific Northwest”, http://wsprs.wsu.edu/AnalyticalLabsEB1578E.pdf
Controlling Iron and Iron Bacteria

- Oxidize the ferrous iron, then precipitate and filter
  - Aeration
  - Chlorine
  - Ozone
  - Other oxidizing agents

- Oxidize, then sequester
Aeration

- Oxygen in air used to oxidize
  - Waterfalls
  - Cascading towers
  - Water Spray/pond
  - Venturi devices

↑ Air is free, effective. No chemical usage.

↓ Takes time for iron to precipitate, so large settling ponds often used
Chlorine

- Commonly used method to manage iron in irrigation water.
- Relatively easy to meter accurately, and easy to monitor appropriate levels.
- Oxidation time depends upon water pH, temperature.
Metering Chlorine

- Add 0.6 ppm Cl for each ppm ferrous iron
  - Liquid sodium hypochlorite solutions are usually 5.25, 10 or 15% chlorine.
  - Chlorine gas is 100% chlorine

- Often, additional chlorine will be needed to oxidize organic compounds, etc in the water.

- Goal is to have about 1 ppm residual free chlorine at the end of the system (emitters furthest from the pump. Use a D.P.D. test.

- Allowed for organic production.
Hazards of Chlorine

- Chlorine gas can be FATAL after a few breaths at 1000 ppm.
- If using chlorine gas, exercise EXTREME CAUTION!
- Liquid hypochlorite + acid = Chlorine gas, so do NOT mix chlorine and acid solutions! Always inject chlorine before filters, and inject acid after filters.
Is Chlorine bad for my plants?

- Some plants, particularly woody perennials such as blueberries, are sensitive to chloride.

- Irrigation water with <105 ppm Chloride is generally thought to be unlikely to cause toxicity.

- Using the 0.6 ppm Cl / 1 ppm Fe rule, treat water with 15 ppm soluble iron with 9 ppm
Is Chlorine bad for my plants?

- It is smart to look at other sources of chlorine, though.
  - Irrigation water.
  - Some fertilizers have high amounts of chlorine – check with your fertilizer dealer.
  - Consider checking Cl⁻ in your soil:
    - check soil EC
    - Include Cl⁻ in your soil test
    - Soil salinity analysis
Ozone

- Often injected with venturi devices
- Commonly used in Aquariums, Water Treatment plants
- Very rapid oxidation, no residual chemicals
- Many systems lack effective metering ability, no residual activity
Other oxidizing agents

- Chlorine dioxide (very rapid oxidization)
- Hydrogen Peroxide
- Peracetic acid (ex: LineBlaster)

Sequestration agents – bind iron so that it won’t precipitate in the system
- Polyphosphates
- Phosphonic acid (ex: CH20’s Sure Flow DS)
- Sodium silicate
Don’t forget maintenance!

- Flush lines regularly
  - Start by flushing once a month.
  - If it takes more than 5 sec for the line most distant from the pump to run clear, you need to flush more frequently

- Backflush filters frequently

- Check Pressures and flows regularly

- Consider an Irrigation System Evaluation
Want more info?

- [http://mtvernon.wsu.edu/Small_Fruit_Hort/SFberrylinks.html](http://mtvernon.wsu.edu/Small_Fruit_Hort/SFberrylinks.html)
Thank You!

Funding

- Washington Red Raspberry Commission
- Washington Blueberry Commission
- Washington Strawberry Commission
- Washington State Commission on Pesticide Registration