Maintenance of Vineyard Drip Irrigation Systems

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Outline
- Components of a vineyard trickle irrigation system
- Design considerations
- Maintenance during the growing season
- End-of-season maintenance
- Beginning-of-season maintenance

Components of a Trickle System
- Water Supply
- Pump
- Regulators
  - Backflow prevention
  - Pressure regulator (flowmeter)
  - Air and vacuum release valve
  - Chemical injection system
  - Pressure gauge
  - Filtration system
  - Check valve
  - Interconnections
- Controller
- Distribution lines
  - Mainline
  - Manifold
  - Lateral
- Emitters

Design Considerations
- Water sources, filtration and treatment
- Drainage of the system

Layout of Typical Drip Irrigation System
Source: OSU publ. F-1511
Design Considerations:

Water Source Issues
- Water quality is critical
  - For crop production
  - For proper function of the trickle irrigation system
- Water analysis/quality test of the source prior to installation is CRITICAL
  - All water sources contain contaminants
  - Evaluate filter needs
  - Chemical compatibilities
  - Water reaction in the soil
- Water sources
  - Well
  - Surface source
    - Spring
      - Running water – stream, river
    - Still water – pond, lake
  - Municipal or rural water system
- Consider quantity of water source

Design Considerations:

Water Source Quality
- Well
- Municipal/rural system
- Spring
- Running surface water
- Pond/lake
- Good
- Poor
- If a review of your water source indicates factors that may cause plugging, special care in design and maintenance MUST be practiced

Design Considerations:

Water Quality Analysis
- Inorganic solids = sand, silt
- Organic solids = algae, bacteria, slime
- Dissolved solids
  - Iron & Manganese
  - Sulfates & Chlorides
  - Carbonates
- pH
- Hardness

Design Considerations:

Plugging Potential of Drip Irrigation Systems
<table>
<thead>
<tr>
<th>Factor</th>
<th>Moderate (ppm)*</th>
<th>Severe (ppm)*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical Suspended solids</td>
<td>50-100</td>
<td>&gt;100</td>
</tr>
<tr>
<td>Chemical pH**</td>
<td>7.0-7.5</td>
<td>&gt;7.5</td>
</tr>
<tr>
<td>Dissolved solids</td>
<td>500-2000</td>
<td>&gt;2000</td>
</tr>
<tr>
<td>Manganese**</td>
<td>0.1-1.5</td>
<td>&gt;1.5</td>
</tr>
<tr>
<td>Iron**</td>
<td>0.1-1.5</td>
<td>&gt;1.5</td>
</tr>
<tr>
<td>Hardness***</td>
<td>150-300</td>
<td>&gt;300</td>
</tr>
<tr>
<td>Hydrogen sulfide**</td>
<td>0.5-2.0</td>
<td>&gt;2.0</td>
</tr>
<tr>
<td>Biological</td>
<td>10,000-50,000</td>
<td>&gt;50,000</td>
</tr>
</tbody>
</table>

* ppm = mg/L  ** pH is unitless  *** Hardness: ppm = gpg x 17

Design Considerations:

Surface Water Quality Issues
- Pond design – to minimize sediment
- Grassed buffer strips
- Settling basins
- Screened intake 1-2 feet below pond surface
- Treatment of pond water with 1 ppm copper sulfate (2.7 lb / acre foot of water) to prevent algae formation and control bacterial slime
Design Considerations:
Surface Water Quality Issues

Design Considerations:
Water Source and Filters
- Municipal Water System - Screen Filter or Disk Filter.
- Well - Screen Filter or Disk Filter.
- River or Creek - Media Filter and Screen Filter.
- Pond or Lake - Media Filter and Screen Filter.
- Spring or Artesian Well - Screen Filter or Disk Filter.
- Organic material in water - Media Filter and Screen Filter
- Sand in water - Screen Filter or Disk Filter.

Design Considerations:
Drainage of the System
- If possible, design system to allow for gravity drainage
- Bury supply lines and manifolds below the frost line
- Include drains whenever possible
  - Upstream and downstream of each control valve
  - At each low point in the system
  - Allow for air entry at high points in the system
  - Make sure that drains are accessible
  - Make sure that water from drains has somewhere to go!
- Include a port for compressed air – install downstream of backflow prevention and pressure regulators/vacuum breaks

Growing Season Maintenance
- Water supply
- Flush physical contaminants
  - Cleaning the filter
  - Flushing the system
- Check for excessive leakage
- Repair breaks or lost emitters
- Fertilizer injection

Growing Season Maintenance:
Troubleshooting Guide
<table>
<thead>
<tr>
<th>Problem</th>
<th>Cause</th>
</tr>
</thead>
<tbody>
<tr>
<td>Turbidity</td>
<td>Suspended clay and silt</td>
</tr>
<tr>
<td>White precipitate</td>
<td>Carbonate precipitation</td>
</tr>
<tr>
<td>Reddish precipitate</td>
<td>Iron precipitation</td>
</tr>
<tr>
<td>Black sandy particles</td>
<td>Iron sulfide precipitation</td>
</tr>
<tr>
<td>Black precipitate</td>
<td>Manganese precipitation</td>
</tr>
<tr>
<td>Reddish brown slime near emitters</td>
<td>Bacteria feeding on iron</td>
</tr>
<tr>
<td>White stringy masses of slime near emitters</td>
<td>Bacteria feeding on sulfur</td>
</tr>
<tr>
<td>Green or slimy matter in surface water</td>
<td>Algae or fungi</td>
</tr>
</tbody>
</table>

Growing Season Maintenance:
Water Supply
- Water supply
- Clean up surface sources
- Measure water level drop in wells during season
- Chemical water treatment
Growing Season Maintenance: Chemical Water Treatment

- **Useful to manage both inorganic and organic problems**
- **Goals of chemical treatment**
  - Cause some particles to settle out or precipitate
  - Cause some particles to remain soluble or to dissolve
- **Place filtration after chemical treatment**
- **Backflow prevention is important**

**Chemical Water Treatment**

- **Chlorine**
  - Kills microbial activity (algae, bacteria)
  - Decomposes organic materials
  - Oxidizes soluble minerals, causing them to precipitate out of solution

- **Acid treatment**
  - Lows water pH
  - Maintains solubility or dissolves manganese, iron, and calcium precipitates
  - Potassium permanganate
  - Oxidizes iron, causing it to precipitate

- **Calcium salts (carbonates, phosphatics)**
  - Water pH > 7.5, bicarbonate levels > 100ppm
  - Acid injection
    - Target pH 4.0 or lower for 30 to 60 minutes daily
    - Hydrochloric, phosphoric, or sulfuric acid used
    - Flush and clean injector

- **Bacteria and algae**
  - Chlorine concentration of 10-20 ppm for 30-60 minutes daily
  - Work by sections through the system, flushing out lines after treatment
  - If emitters are plugged, higher concentrations of chlorine may be needed to decompose organic matter

- **Iron over 0.1 ppm**
  - Aeration and settling
  - Chlorine precipitation
    - Concentration of Cl depends on the concentration of Fe - 3.7 ppm per 1.0 ppm Fe
  - pH control
    - Low pH (2.0) - iron dissolves
    - High pH - iron precipitates
  - Potassium permanganate
  - Combinations – more than 10 ppm Fe or organically complexed iron

- **Goals of chemical treatment**
  - Cause some particles to settle out or precipitate
  - Cause some particles to remain soluble or to dissolve
  - Place filtration after chemical treatment
  - Backflow prevention is important
Growing Season Maintenance: Chemical Water Treatment
- Acid injection rate calculation
- Amount of acid needed to treat a system
  - Strength of acid used
  - Buffering capacity of the irrigation water
  - Desired pH of water
- Perform a titration to arrive at the acid volume:water volume ratio
- Calibration of injection pumps is critical

Growing Season Maintenance: Fertigation
- Drip irrigation can supply soluble materials such as fertilizers by chemigation
- Analyze water source for precipitate potential through water/fertilizer interactions
- Test fertilizers for solubility, especially P sources
- Backflow prevention is critical
- Use proper equipment and procedures
  - Inject upstream of filters
  - Allow for complete mixing
  - Pressurize system before injection
  - Flush lines at the end of injection to remove residue

Growing Season Maintenance: Control Area
- Control area
  - Regularly check each component for proper function as per manufacturer’s guidelines
  - Remember – pressure gauges are your indicators!

Growing Season Maintenance: Filters
- Filter
  - Filters must be cleaned when pressure loss across filter exceeds 5-10 psi
  - Screen filter - manual or automatic flush
  - Disc filter – flush
  - Sand media - backflush to clean

Growing Season Maintenance: Supply Lines and Laterals
- Flush lines at intervals
- Repair breaks and areas of leakage – inspect weekly

Growing Season Maintenance: Emitters
- Emitters
  - Check frequently for plugging
  - Check for lost emitters
  - Control weed growth under trellis
    - Weeds compete for water
    - Weeds compete for injected fertilizers
    - Weeds interfere with wetting patterns
    - Weeds make maintenance more difficult
Growing Season Maintenance: Emitters

- Emitters
  - Root intrusion
    - CI injection at 100ppm for 1 hour
    - Injection of trifluralin or copper sulfate
  - Soil ingestion
    - Install vacuum relief valves on submains and manifolds, especially at high points
    - Soil surface installations – place emitter orifices up

Beginning of Season Maintenance

- Check controls
- Flush and clean filters
- Flush the system
- Leak check the system; check emitters and wetting patterns

Beginning of Season Maintenance: Check Controls

- Place controls in system if removed
- Check each component for proper function as per manufacturer’s guidelines

Beginning of Season Maintenance: Flush the System

- Place controls in system
- Flush mainline for 20 minutes, with manifold valves closed
- Flush each manifold for 5-10 minutes
- Open ends of each lateral in a zone
- Flush laterals in each zone until water runs clear

Beginning of Season Maintenance: Flush and Clean Filters

- Make sure that filters are clean
- Replace cartridges or media if needed

Layout of Drip Irrigation System
**Beginning of Season Maintenance:**  
**Leak Check the System**
- Close lateral ends
- Run system with water for 20 min to remove air
- Check pressure throughout the system – note any areas with more than 20% variation in flow rate, and correct
- Walk vineyard, noting plugged emitters, leaks and breaks; repair any problems

**End of Season Maintenance**
- Turn off the water source
- Winterize the control area
- Drain all lines
  - Open manual drains
  - Remove plugs at ends of laterals
  - Use compressed air to remove water if needed
  - Replace end coverings and close drains

**End of Season Maintenance:**  
**Turn Off the Water Source**
- The main shut off valve must be freeze proof!
  - Below frost line
  - In heated room
  - Insulated

**End of Season Maintenance:**  
**Winterize the Control Area**
- Disconnect power if needed
- Remove controls (backflow prevention, filters, gauges, injection equipment)
- Drain water from everything!
- Consider storing controls in a heated protected area

**End of Season Maintenance:**  
**Drain All Lines**
- Two methods
  - Drain valves
  - Blowing out the system
- Drain valves
  - Open all drain valves, allow water to drain
  - Remember to leave all valves open!
Any Questions?

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