Biofilm Management

California 2017

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SCRI - CLEAN WATER^3
REDUCE, REMEDIATE, RECYCLE

There are many aspects of water quality. Know what you are treating for…

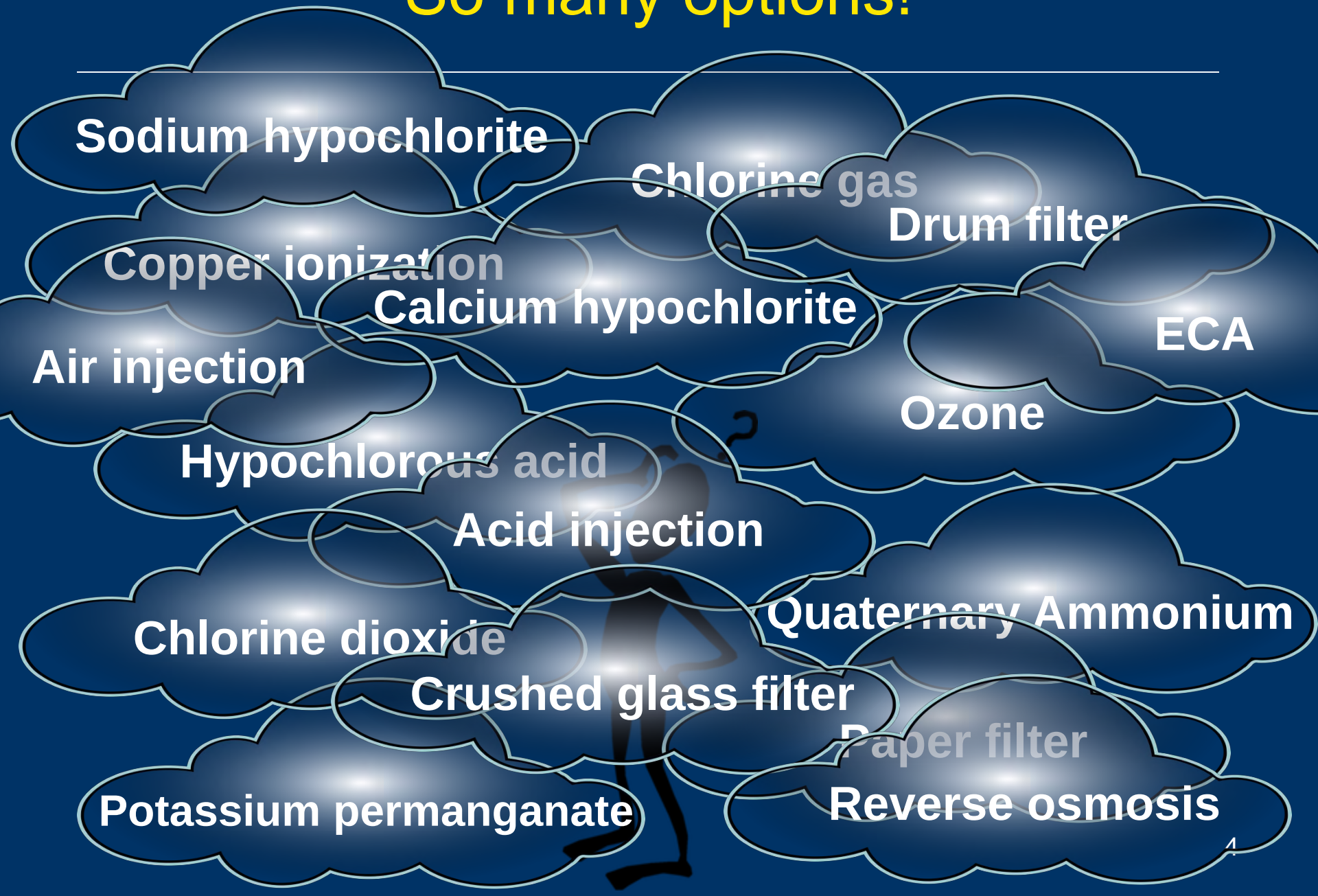
- Pathogens, algae, biofilm/microbes, (biological)
- Alkalinity, EC, specific salts, agrichemicals (chemical)
- Particles (physical)

- Before buying equipment, get your water tested

Why do emitters clog up?

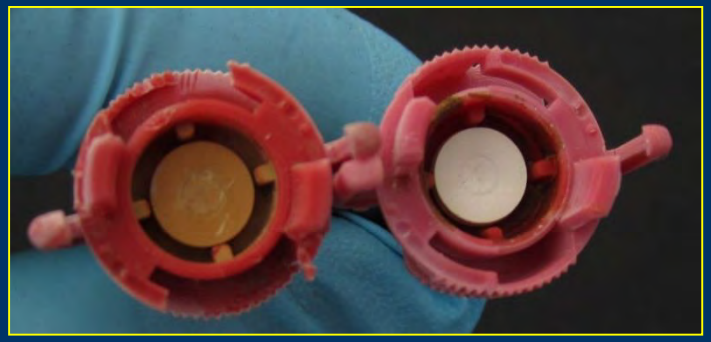
- Biological
  - Slimy organic material
- Chemical:
  - Soak in vinegar (low pH) – cleans up?
  - Send solution to testing lab to analyze specific ions
- Sediment:
  - When soak in water, solid particles drop out

So many options!



First, identify the type of clogging..

- Biological issue in Florida



- Chemical/Particle issue in New Jersey

Case Study 1: Biological issue

New greenhouse
5000 gal/day

Clogged drippers

Well water

Water-soluble fertilizer and line cleaner

Screen filter (140-mesh 100 micron)

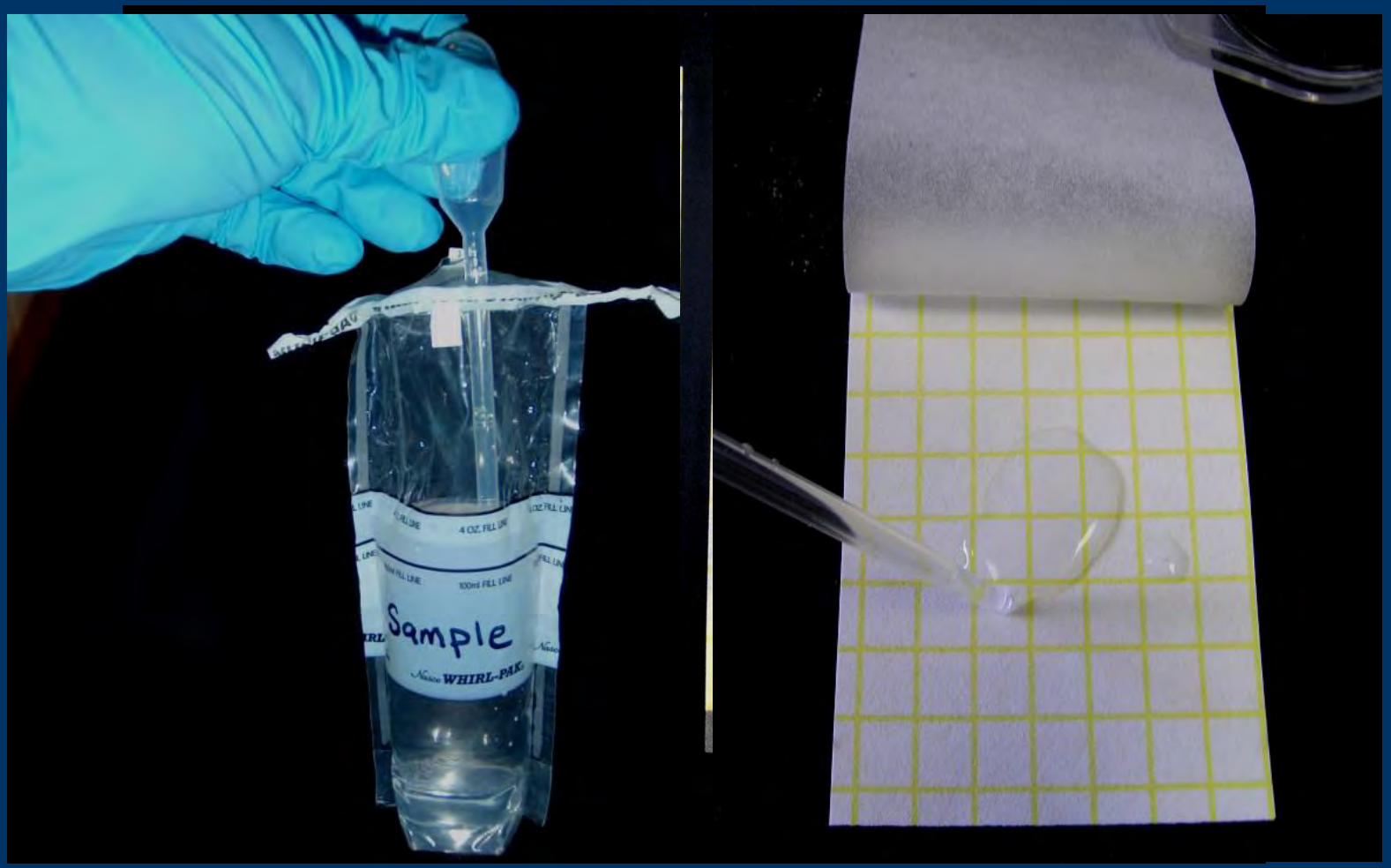
Plus 200 mesh (74 micron) small screen filters

Water quality report

Location	pH	Electrical conductivity (EC, in mS/cm)	Dissolved Iron (ppm)	Total suspended solids (TSS, in mg/L)
Well head before filter	6.1	0.1	1.0	0
After filter	5.8	0.1	0.8	0
Greenhouse emitter with fertilizer	5.6	1.9	1.9	6.3

Biofilm:3M Petrifilm method

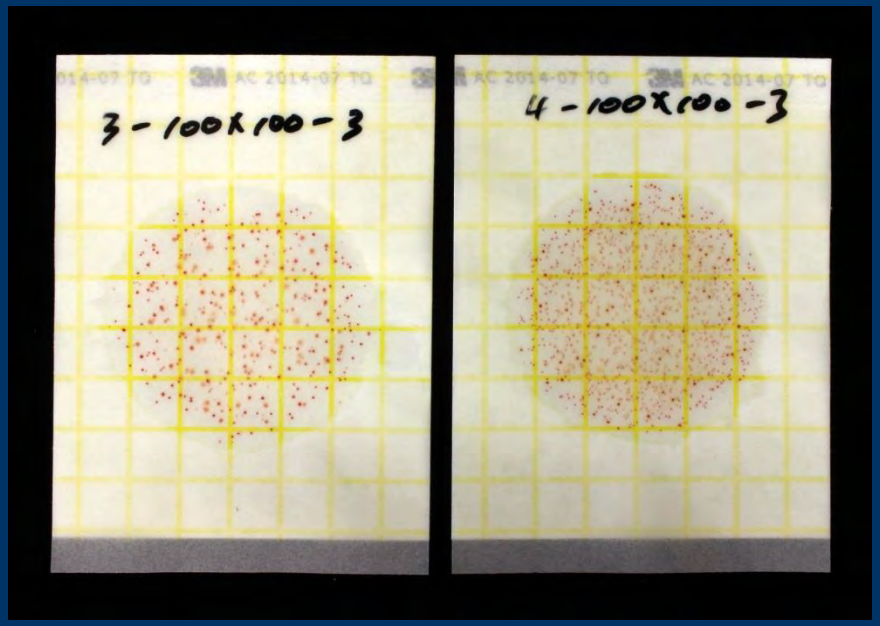
Dustin Meador



>5,000 cfu/mL bacteria = high biofilm risk

Bacteria counts

Location	Bacteria count (colony forming units/milliliter, cfu/ml)
Well head before filter	48,300
After filter	101,100
Greenhouse emitter	2,117,000



Sodium hypochlorite (bleach) at 2 ppm to oxidize iron and bacteria

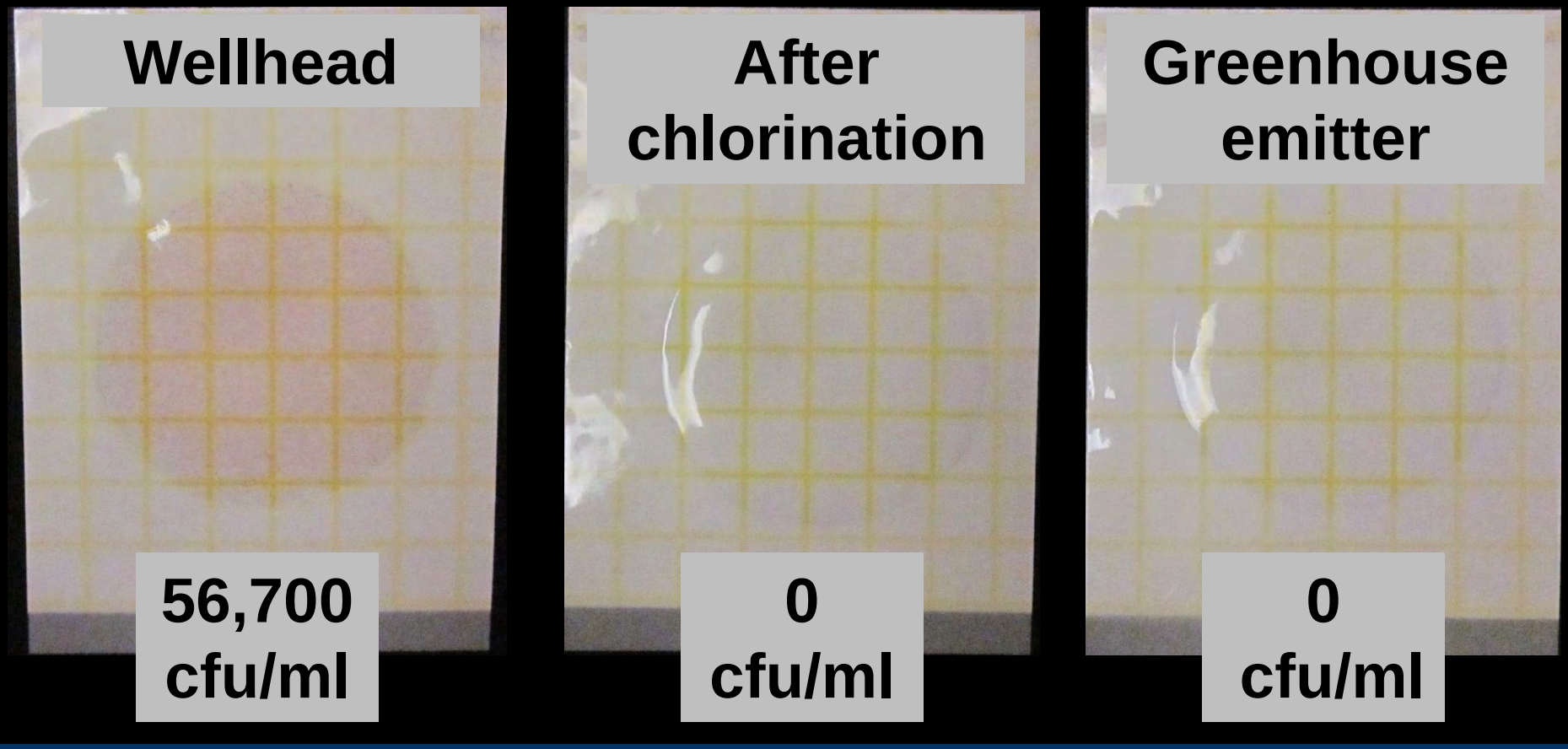
Two 36-in (0.9 meter) diameter sand filters,
#20 crushed silica (190-250 micron)

Rapid pay back

Fixed Costs:	
Sand media filter	$5082
PVC pipe and fittings	$2228
Flow meter	$470
Chlorine tank	$91
Labor (estimated)	$1800
TOTAL	$9671
Variable Costs:	
Sodium hypochlorite	$66/year
	$0.07 / 1000 gallons* treated
	(10% Cl by weight, $1.80/gallon)
Benefits:	
Current value of marketable trees	$280000
Previous value of marketable trees	$168000
Net gain in value (Year 1)	$112000

*Divide price per gallon by 3.8 to convert to liters

After treatment system installed



Iron removal from back-flushed filter

General biofilm control: Steps

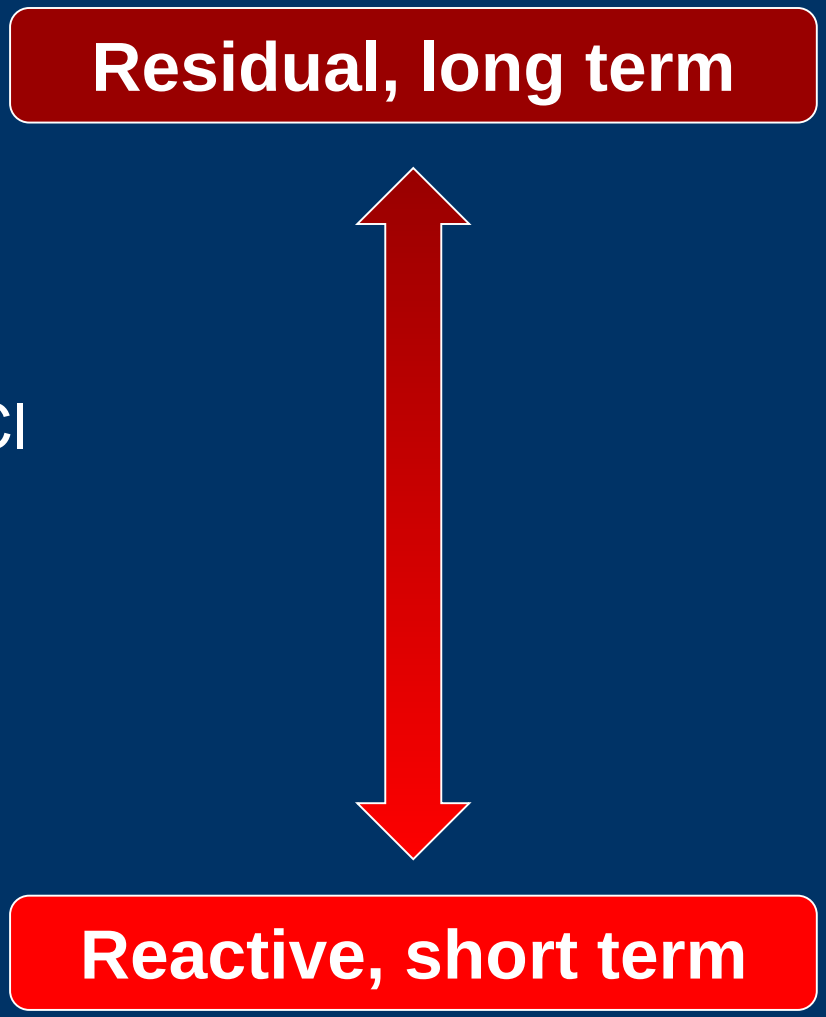
1. Remove small emitters & open blow-out lines, flush system

2. Sanitizing shock (not onto plants):
   Line cleaner or
   Chlorine dioxide (20 ppm) or
   Chlorine (20-50 ppm) or
   Peroxyacetic acid

3. Suppress buildup:
   Filtration plus sanitizing agent at a low concentration

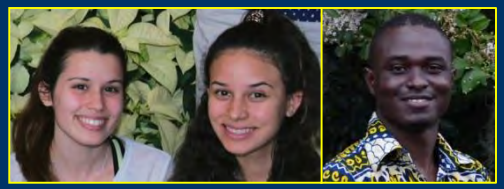
Biofilm control and residual

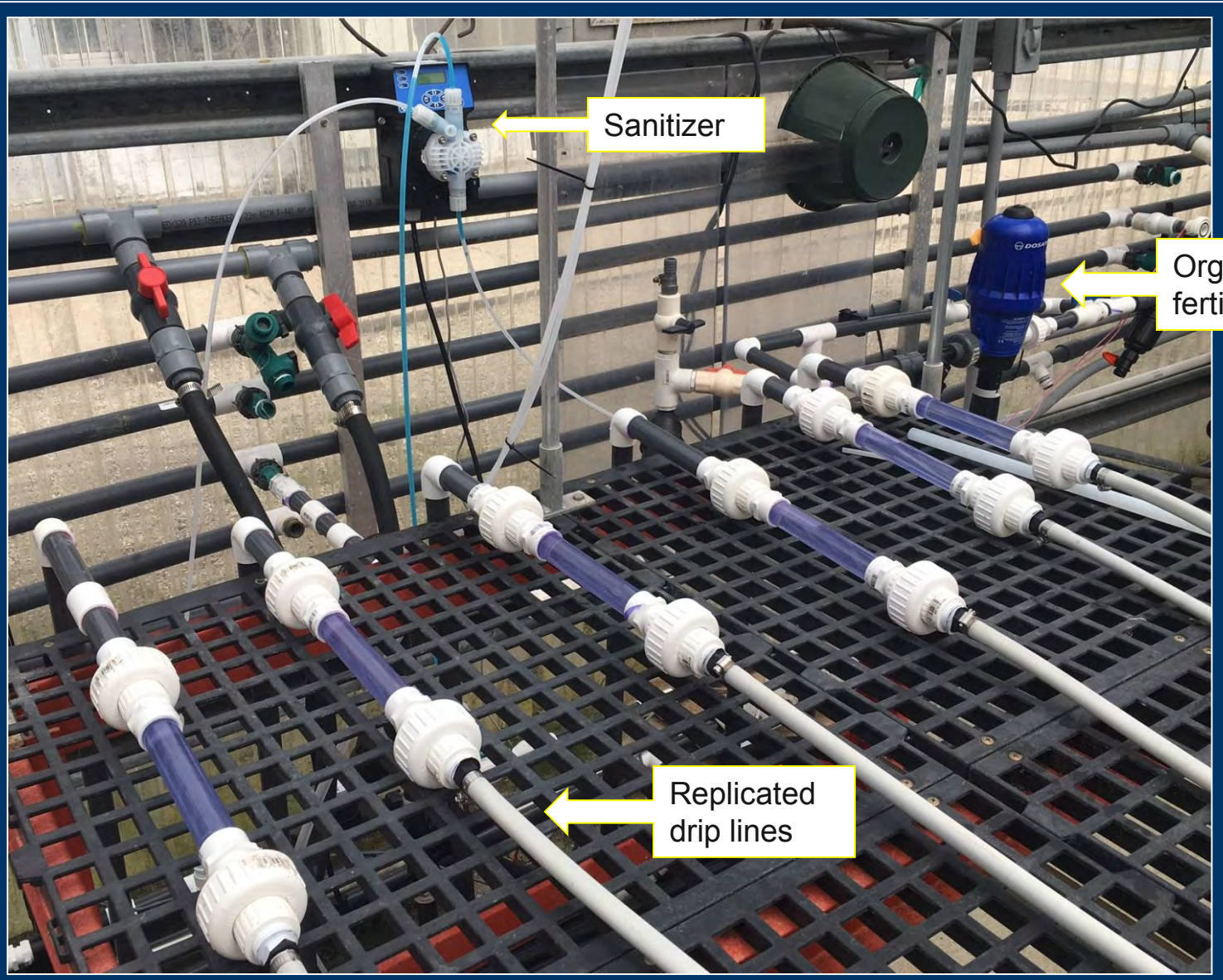
- Copper ionization
- Chloramines
- Peroxyacetic acid
- Quaternary Ammonium Cl
- Chlorine
- Chlorine dioxide
- Ozone
- Ultraviolet light, heat, filtration



Clean WateR3 research: biofilm testing

Andrea Neira
Jesenia Mosqueda
Ulrich Adegbola





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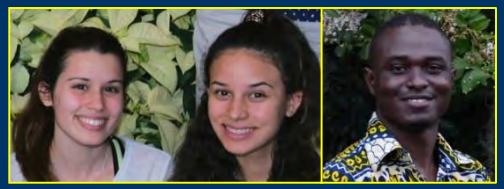
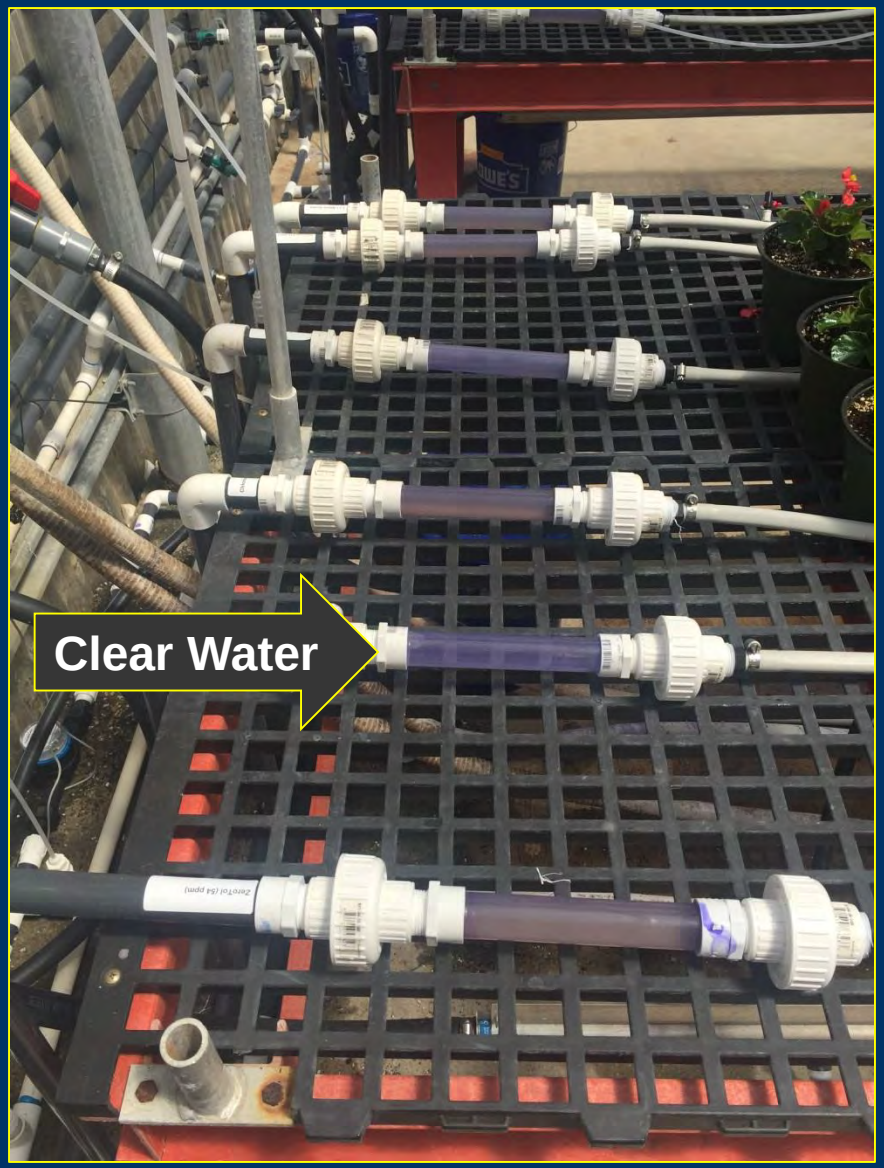


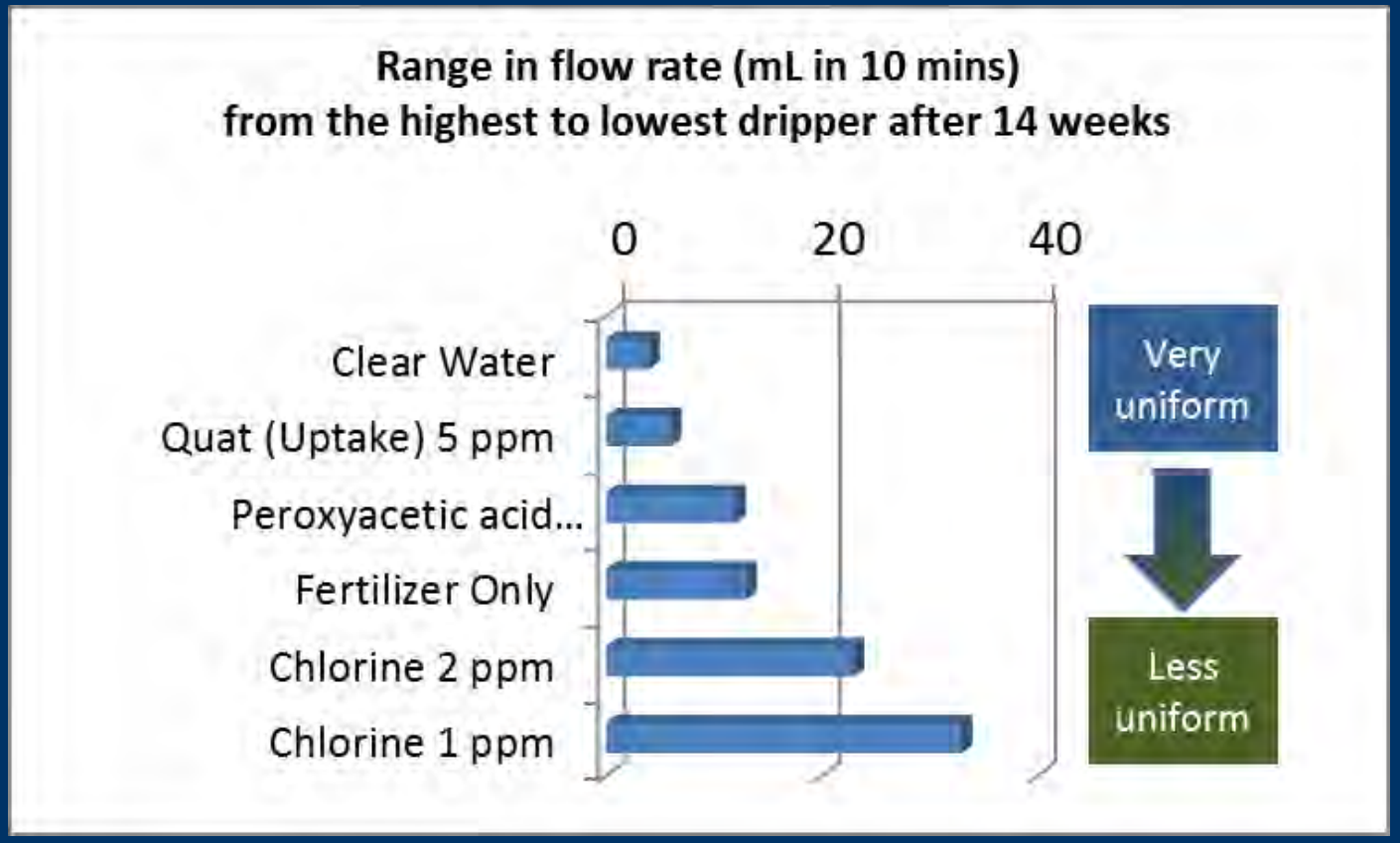
No treatment very strong suppression of biofilm other than clear water



Measured crop growth and dripper flow rate

- No effect on begonia growth from any sanitizer

Chlorine was least effective at keeping drippers flowing uniformly in this pilot trial



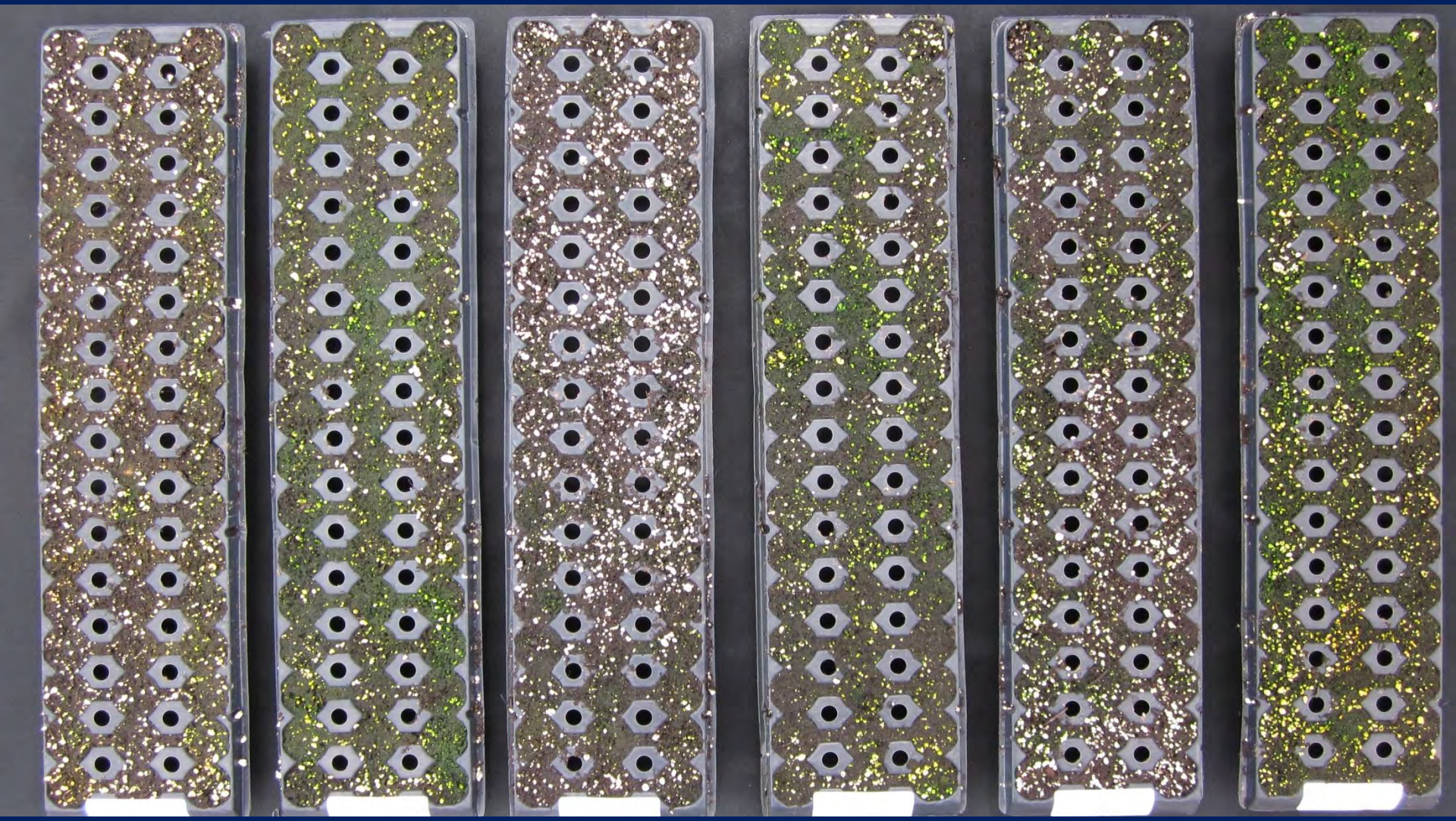
- A range of 0 would mean all drippers have exactly the same flow rate on a bench

Algae control and phytotoxicity trials: Experimental set up

Javier Lopez

Algae control trials: Experimental set up

No fertilizer & some sanitizers reduce algae



No fertilizer | Fertilizer | 2ppm Copper sulfate | 1:5000 X3 | 1:1000 ZeroTol | 0.5ppm ClO_2

Calcium nitrate at 50ppm N applied continuously in mist for 2 Weeks

If you are suppressing algae, you are probably also suppressing crop growth

No fertilizer	Fertilizer	2ppm Copper sulfate	1:5000 X3	1:1000 ZeroTol	0.5ppm ClO_2

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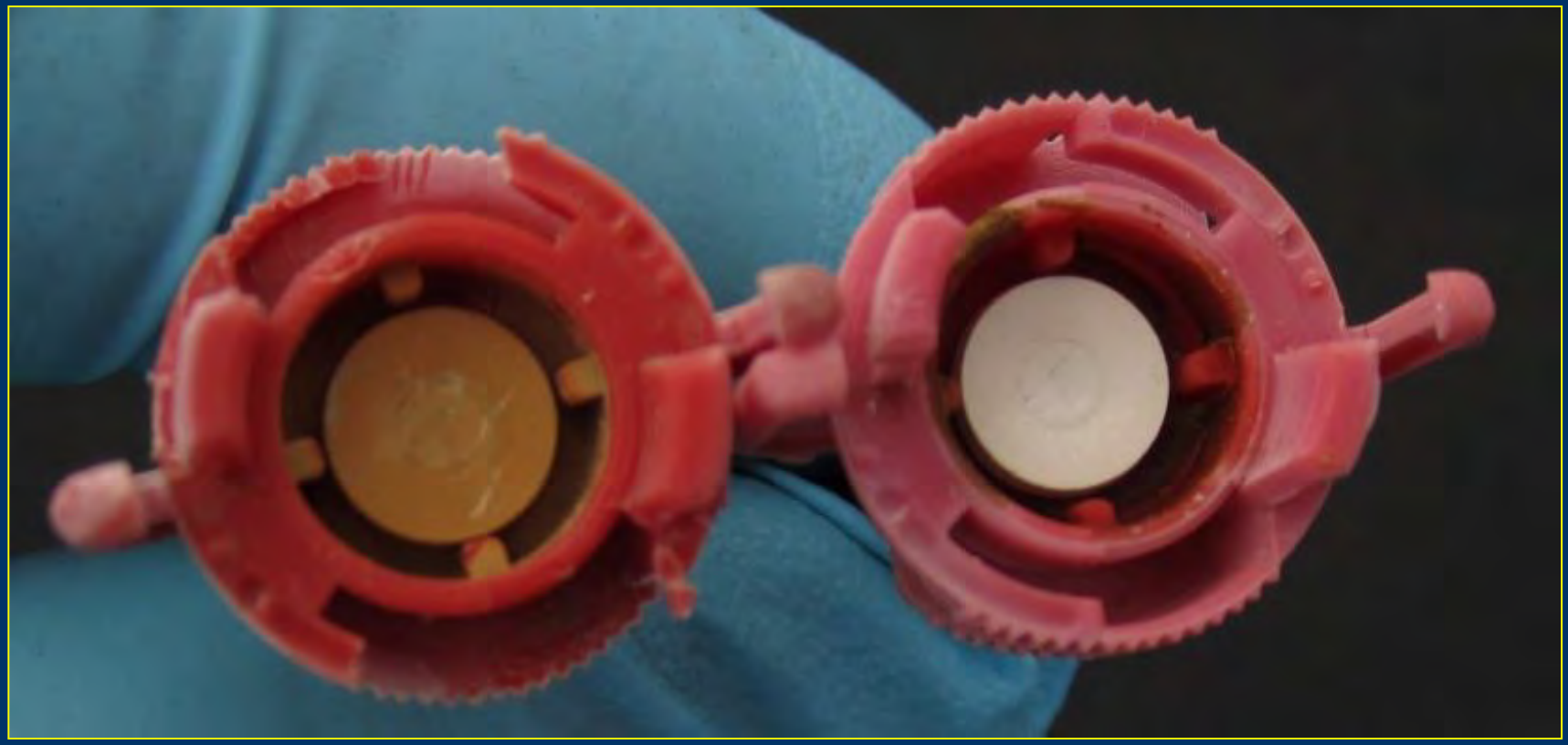
Case study 2: Chemical/Particle



- 25-acre greenhouse, 21M gal per year

Case study 2: not all clogging is from biofilm

- 1 to 2 ppm of iron in well water when tested by lab.
- Remember that lab only tests dissolved iron, not solid rust
- Add a drop of bleach and leave water overnight

Iron deposits

Iron deposits

Annual cost of iron deposits

- 13,468 hours of labor (6.5 workers) to inspect, clean and replace clogged emitters, filters, and irrigation lines @ $11/h = $148,148
- $4,449 to replace new irrigation lines or emitters
- Total annual cost of $152,597
- Plus shrinkage, labor to remove stained leaves
- What would you do?

Potassium permanganate oxidizer

Simple injector system

Greensand filters

Automatic back flush

Before water treatment

- Total annual cost (labor & materials) of $152,597

Treatment costs

- Equipment and installation $200,000
- Potassium permanganate $0.84/1,000 gal, or $17,640 per year

Payback within two years

Thank You!

- Test why clogging is occurring
- Only add a treatment if you have an issue
- Choose an appropriate technology for your problem

CleanWateR3.org