

Water Treatment Overview

Grant Johnson

South Coast REC

Title: Urban Agriculture
Technology Advisor

Gejohnson@ucanr.edu







Before Buying Technology...

- **Know what you are treating**
- **Biological**
 - Plant pathogens, algae, biofilm, human pathogens
- **Chemical**
 - Alkalinity, EC, specific ions, agrichemicals, dissolved oxygen
- **Physical**
 - Particles, sediment, organic material, turbidity

Many Options

Sodium
hypochlorite

Nanobubbles

Chlorine
dioxide

Ozone

Quaternary
Ammonium

Cold plasma

Drum Filter

Sand
Filtration

Reverse
Osmosis

Paper filter

Chlorine gas

Acid injection

Match solutions to problems



- Chemical problems – manipulate chemistry
 - Acidification, oxidation, reverse osmosis



- Biological problems – IPM, sanitizing agent
 - Chlorine, chlorine dioxide, copper ionization, hydrogen peroxide, ozone,..



- Particle problems – oxidation, flocculation, settling, filtration



Pathogen control, provide adequate dose

Technology	Efficacy tests for <i>Phytophthora</i> zoospores	Contact Time
Filtration	0.1 – 0.5 microns (membrane)	Point
Chlorine	2 ppm at pH 6.0 -7.0	< 2 min
Chlorine dioxide	2.6 ppm	2 min
Copper	0.8 to 5.8 ppm depending on formulation	10 min to 2h
H ₂ O ₂ / peroxygens	185 ppm H ₂ O ₂ + 120 ppm PAA (1:1,000 SaniDate 12.0)	1 min
Ozone	1.5 ppm	8 min
Slow Sand Filtration	Antagonistic microbes + filtration	Hours to days
UV Light	75% transmittance of 254 nm	Point


Chemical Water Quality Treatment Systems														
Technology	Notes	Pre Treatment Required	Treatment Range						Reaction Time	Residual Effect*	Reject Water Waste?	Footprint	Costs	
			Solids / organic material	Pathogens	Nutrients		Agri - chemicals	Controls Biofilm					Capital	Operating
					N	P								
Chlorine	Caution with chloramine formation when using in fertigation solutions	Pre-filtration	✓	✓			Some	✓	Minutes	++		Small	\$ - \$\$	\$
Chlorine Dioxide		Pre-filtration	✓	✓			Some	✓	Minutes	++		Small	\$ - \$\$\$	\$\$ - \$\$\$
Peroxyacetic acid	(PAA) is a combination of acetic acid and hydrogen peroxide	Pre-filtration	✓	✓			Some	✓	Minutes	++		Small	\$	\$\$ - \$\$\$
ECA	Chlorine 2-10 ppm may damage lettuce	Softening	✓	✓				✓	Minutes	+		Small		
Ozone		Pre-filtration	✓	✓			Some	✓	Minutes	+		Medium	\$\$\$	\$
Copper Ionization		Pre-filtration		✓					Hours	++		Small	\$\$\$	\$
Peroxyacetic acid + UV	Synergistic Effect	Pre-filtration	✓	✓			Some	✓	Minutes	++		Medium	\$\$\$\$	\$\$\$ - \$\$\$\$
Peroxyacetic acid + Ozone	Synergistic Effect	Pre-filtration	✓	✓			Some	✓	Minutes	++		Medium	\$\$\$\$	\$\$\$ - \$\$\$\$
Ozone + UV	Synergistic Effect	Pre-filtration	✓	✓			Some	✓	Minutes	+		Medium	\$\$\$\$\$	\$\$
Deionization	Higher purity than typically needed	Pre-filtration and Reverse Osmosis to reduce cost	✓	✓	✓	✓	✓		Minutes		+++	Medium	\$\$\$\$\$	\$\$\$

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Ozone		Pre-filtration	✓	✓			Some



Best Practices Guide Water Circularity


for Controlled Environment Agriculture (CEA) Operations




REDUCE • REMEDIATE • RECYCLE

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Ponds & reservoirs




How much maintenance is required to keep constructed wetlands working?



What steps do I need to take to install a constructed wetland?




What type of plants should I use to establish constructed wetlands?




Have other nurseries installed constructed wetlands to treat runoff water?

Workshops, conferences and outreach




Take Our
Impact
Survey

WATER TREATMENT
Plants with purpose
Construct wetlands and plant remediation systems for luxury water treatment practices.
by LUCAS LARSEN, JAMES WILSON, and SARAH DENT



Water: Research you can use on water conservation, recycling and treatment
Clean Water³
Research you can use on water conservation, recycling and treatment



Back Pocket Grower

Tools Training Search [Español](#) 

Training and crop management tools for nursery and greenhouse growers on the go.



TOOLS



TRAINING



Grower tools

Our grower tools help you make informed management decisions on water quality issues.

- The [WaterQual tool](#) interprets water quality tests for sources used in irrigation in greenhouses and nurseries. ([Video guide](#))
- The [Waterborne solutions tool](#) summarizes published research on control of plant pathogens and algae.
- The [Reservoir Calculator Tool](#) can help you determine how much water is in your reservoir for current needs or future planning ([video guide](#))
- Use the [Irrigation Volume Tool](#) to determine how much water you are applying at each irrigation cycle for part or all of your operation ([video guide](#))
- The [Pond Refill/Runoff Volume Tool](#) will help you determine



Filter type	Material	Cost \$/1,000 gal			
		Capital	Consumable	Labor	Total
Metal screens	Pressurized inline screen	\$0.02	\$0.00	\$0.00	\$0.02
	Coarse static screen filter	\$0.05	\$0.00	\$0.01	\$0.06
	Vibrating screen filter	\$0.12	\$0.04	\$0.01	\$0.17
	Drum screen filter	\$0.05	\$0.01	\$0.01	\$0.07
Fiber media ("paper")	Polyester (90%), cotton (10%)	\$2.09	\$0.78	\$0.10	\$2.97
	Nylon	\$0.15	\$0.16	\$0.02	\$0.33
	Polyester	\$0.04	\$0.13	\$0.02	\$0.19
	Polyester	\$0.04	\$0.02	\$0.02	\$0.08
Sand-glass	Sand-glass media	\$0.10	\$0.00	\$0.00	\$0.11
Membrane	Reverse osmosis	\$1.22	\$0.04	\$0.49	\$1.75

Calculators to help guide your decisions

Nutrient solutions

Substrates

Economics of production

Climate (light, temperature & humidity)

Production week number

Water quality

Waterborne solution: Treatments for pathogens

WaterQual: Interpret your water test report

Waterborne solutions: treatments & pathogens

Organisms

Acidovorax
Agrobacterium
algae
Alternaria
Botrytis
Clavibacter
Colletotrichum
Corynebacterium

Phytophthora

Activated peroxygen/hydrogen peroxide

- Sanidate 12.0® (18.5% hydrogen peroxide and 12% peroxyacetic acid) applied at 100 ppm hydrogen peroxide + 120 ppm peroxyacetic acid) with 1 minute contact time resulted in 100% mortality in nursery runoff and pond water and 88% in greenhouse water containing *Phytophthora* spp.
- Resulted in 100% mortality in nursery runoff and pond water and 88% in greenhouse water under lab conditions.

Choppakatla, V.K. 2009. Evaluation of SaniDate® 12.0 as a bactericide, fungicide and disinfectant for irrigation water treatment. BioSafe Laboratory. Final Report 09-004.

Biosurfactants

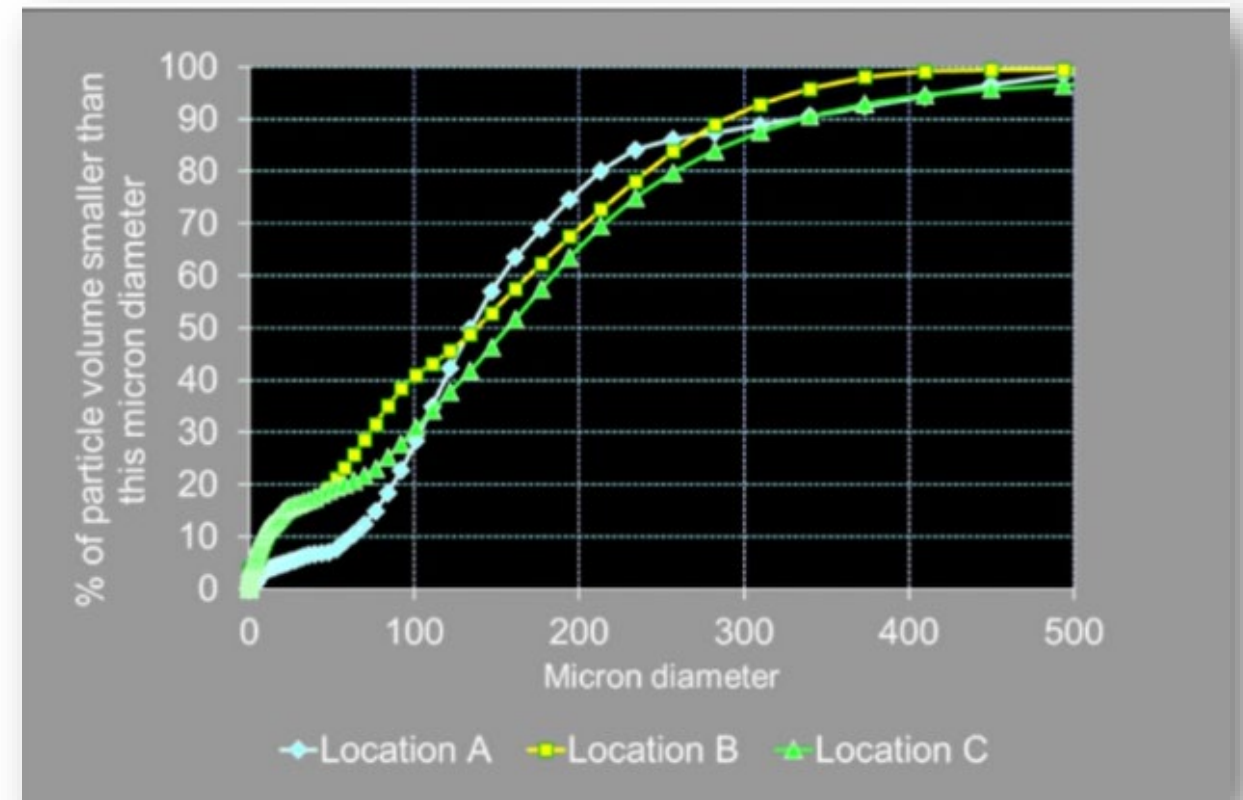
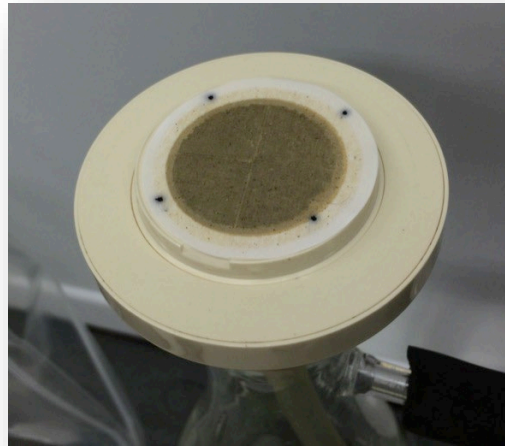
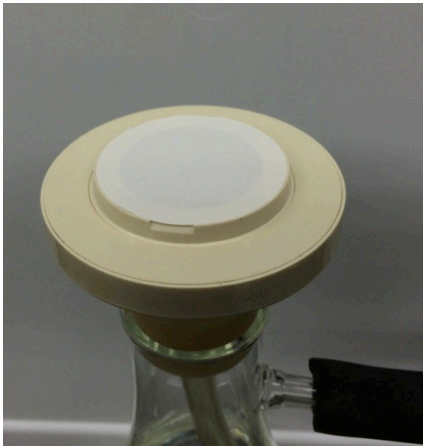
Phytophthora capsici

Test if your treatment is working



Test if your treatment is working

- For most irrigation needs:
Less than 5 mg/L total suspended solids (TSS) <5 NTU turbidity
- Filter to a finer pore size than your smallest emitter



1. Evaluate current strategy

2. Reference resources

1. Resource Innovation Institute .org

2. Clean Water 3 .org

3. Back Pocket Grower .org

3. Test treatment is working