



Cooperative Extension Service

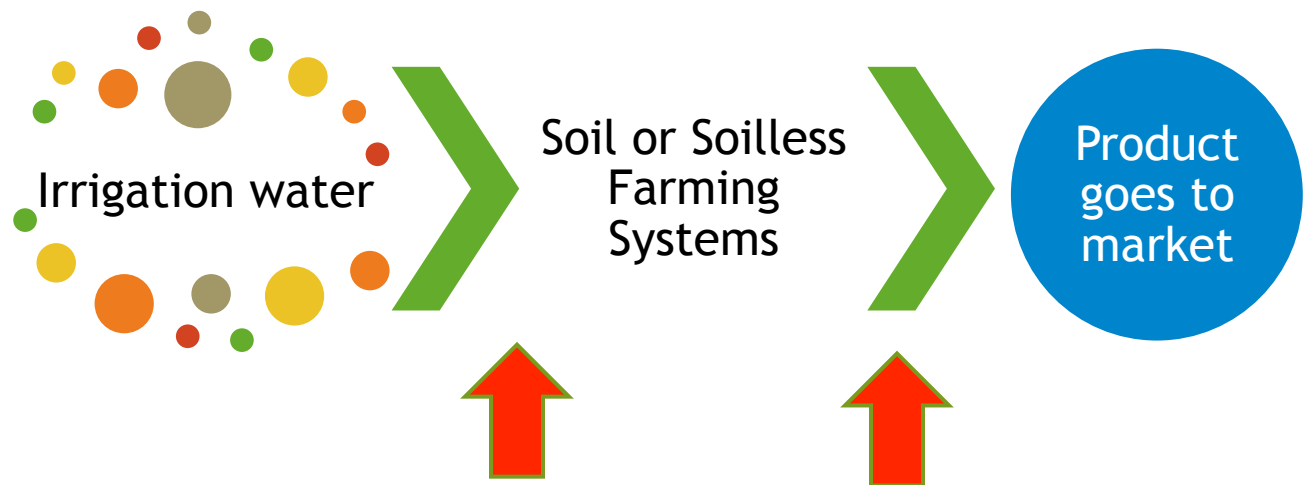
College of Tropical Agriculture and Human Resources
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WHITE PAPER: Evaluation of Various Pathogen Remediation Strategies for Soil and Soilless Farming Systems in Anticipation of the New Food Safety Guidelines

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August 2014

OBJECTIVE: Evaluate various pathogen reduction steps for soil and soilless farmers to consider when *E. coli* action thresholds are surpassed (non-contact irrigation water).



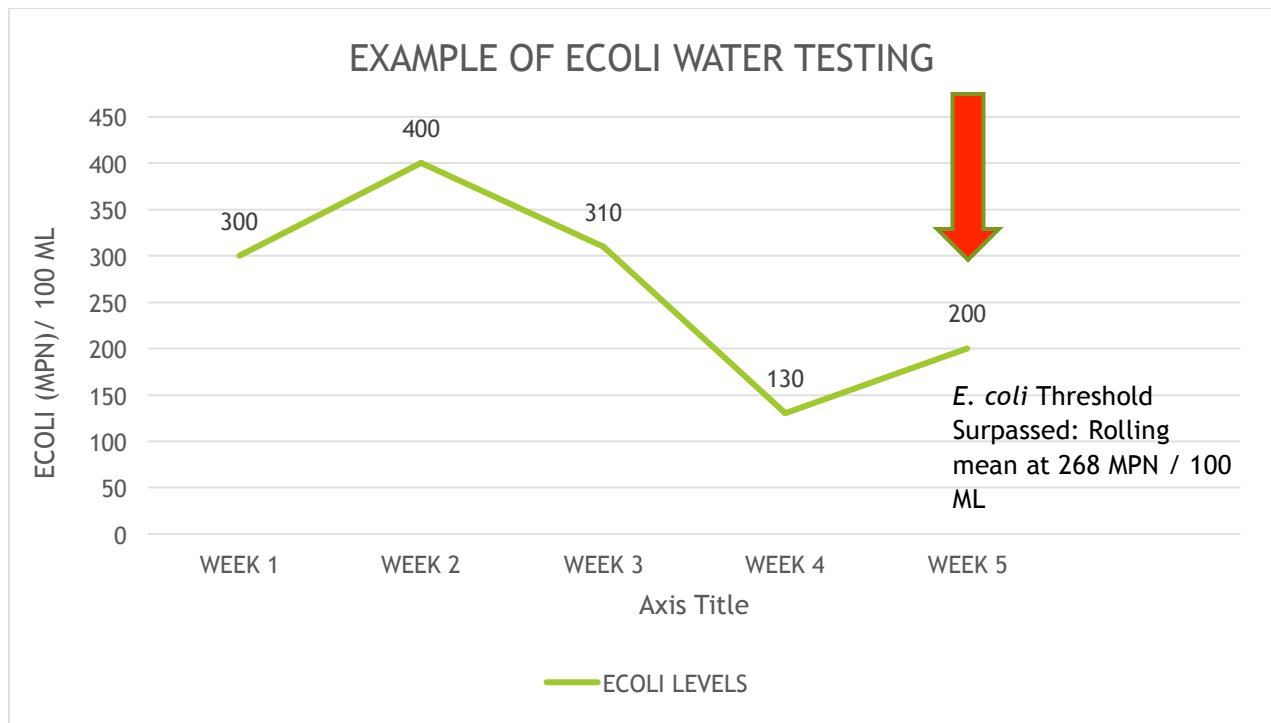
PATHOGEN REDUCTION STEP #1

If the rolling geometric mean ($n=5$) or any one sample exceeds the acceptance criteria, then the water shall not be used whereby edible portions of the crop are contacted by water until remedial actions have been completed and generic *E. coli* levels are within acceptance criteria:

≤ 126 MPN /100 mL (rolling geometric mean $n=5$) and
 ≤ 576 MPN /100 mL for any single sample.

PATHOGEN REDUCTION STEP #2: Post Harvest food grade sanitizer

We utilized a hypothetical situation where the weekly water samples caused the rolling geometric mean to EXCEED acceptable levels.



7/7/14-Water testing results: *E. coli* 200 MPN/ 100 ML

6/11/14-Water test results: *E. coli* 130 MPN / 100 ML

5/9/14-Water testing results: *E. coli* at 310 MPN / 100 ML

REMEDIAL ACTION: IMPLEMENT & EVALUATE VARIOUS PATHOGEN REDUCTION CORRECTIVE MEASURES

BOD 5 day, EPA 405:1, MDL 1.0 mg/L: <1

Chemical Oxygen Demand: EPA 410:1, MDL 5.0 mg/L: 7.3

Total dissolved solids: EPA 160:1: MDL 1.0 mg/L: 36

CHLORINE TREATMENTS: 200-400 ppm

Scenario #1: Chlorine 200 ppm with 2 in line filters (120-175 micron) and 1 coffee filter (mimic sand filter)



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graph LR
    A[Incoming water] --> B[BEGINNING Ecoli-130  
pH 7.4]
    B --> C[Treatment]
    C --> D[200 ppm chlorine (2 filters)  
ORP: 661]
    D --> E[ENDING Ecoli < 1  
pH 9.2]
  
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Incoming water

BEGINNING Ecoli-130
pH 7.4

Treatment

200 ppm chlorine (2 filters)
ORP: 661

ENDING Ecoli < 1
pH 9.2

The diagram illustrates the water treatment process through five sequential stages, each represented by a chevron-shaped box pointing to the right:

- Incoming water** (Green box)
- BEGINNING Ecoli-130 pH 7.4** (Green box)
- Treatment** (Green box)
- 200 ppm chlorine (2 filters) ORP: 620** (Yellow box)
- ENDING Ecoli < 1 pH 9.7** (Purple box)

Incoming water

BEGINNING Ecoli-130
pH 7.4

Treatment

UV WITH
ORP 495

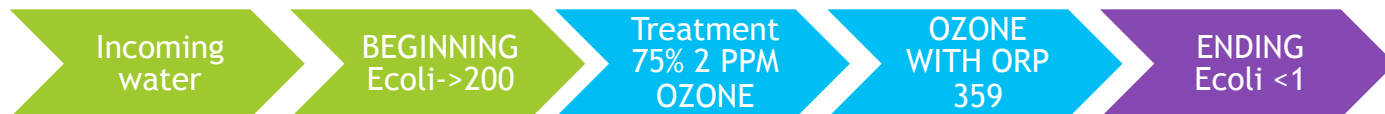
ENDING Ecoli
<1
pH 7.0

The diagram illustrates the water treatment process through a series of six chevron-shaped stages:

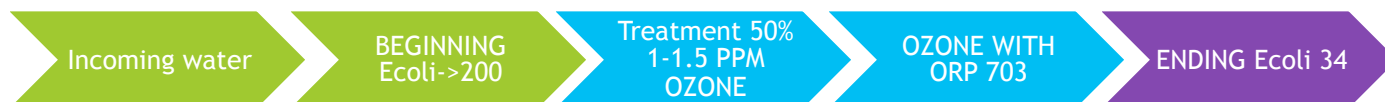
- Incoming water** (light green chevron)
- BEGINNING**
Ecoli-130
pH 7.4 (green chevron)
- Treatment** (light green chevron)
- Ozone** (blue chevron)
- UV ORP 495** (dark blue chevron)
- ENDING**
Ecoli <1
pH 5.2 (purple chevron)

The diagram illustrates the effect of ozonation on E. coli levels in water. It shows two horizontal paths, each representing a different treatment scenario. The top path shows a treatment with 25% 2 PPM OZONE, resulting in an ending E. coli count of 83. The bottom path shows a treatment with 50% 2 PPM OZONE, resulting in a significantly lower ending E. coli count of 6. Both paths start with 'Incoming water' and 'BEGINNING Ecoli->200'.

Path	Starting Condition	Treatment	ORP Level	Ending E. coli Count
Top	Incoming water BEGINNING Ecoli->200	Treatment 25% 2 PPM OZONE	OZONE WITH ORP 523	ENDING Ecoli 83
Bottom	Incoming water BEGINNING Ecoli->200	Treatment 50% 2 PPM OZONE	OZONE WITH ORP 462	ENDING Ecoli 6

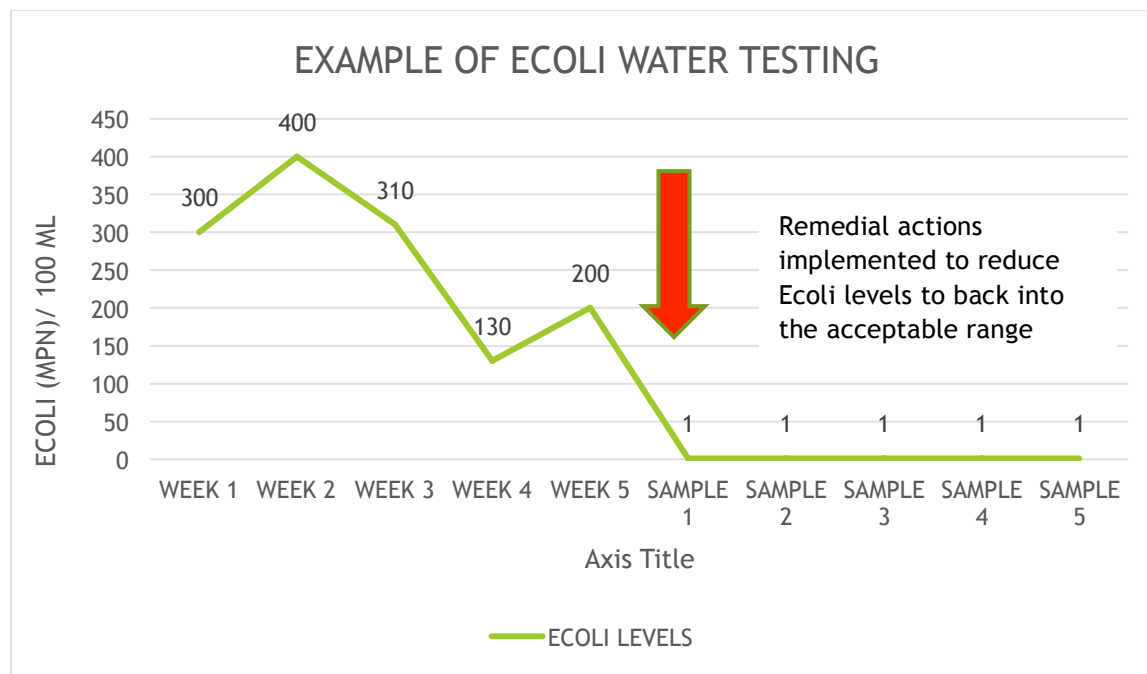


OZONE TREATMENT: 4 HOUR UNIT



PERACETIC ACID: 3 PPM

Scenario #7 Peracetic acid (OMRI APPROVED) shocked irrigation water with 2 in line filters (120-175 micron)



Summary:

We evaluated different corrective measures such as ozone, UV, chlorine, and peracetic acid to reduce the microbial activity of *E. coli* in irrigation waters. All remedial treatments evaluated hold promise for soil and soilless farming systems. Water quality issues need to be taken into account when implementing a remediation program. Remediated water should be re-tested before it is permissible to reinstate its use. If a single sample has *E. coli* levels greater than 576 MPN / 100 ML, the remedial treatment should be repeated. Do not utilize contaminated water or have it in contact with the edible portion of crops until remedial actions have been completed and generic *E. coli* levels are back within acceptance criteria ranges:

≤126 MPN /100 mL (rolling geometric mean n=5) and **≤576 MPN /100 mL** for any single sample.

PROCESS: 2 inline filters



3rd filter as a coffee filter to mimic sand filter. Utilize chlorine and ORP meters



CHLORINE STRIPS, ORP METER, OZONE MACHINE



UV SYSTEM, THEN OZONE + UV

Special thanks to Senator Donovan Dela Cruz, Fred Lau, Bradley Fox, Vincent Kimura, Sri Hartono, and Koon Hui Wang for advice and consultation.