Cooperative Extension Service
College of Tropical Agriculture and Human Resources
University of Hawai'i at Mānoa

DRAFT

Evaluation of Various Pathogen Remediation Strategies for Soil and Soilless Farming Systems in Anticipation of the New Food Safety Guidelines

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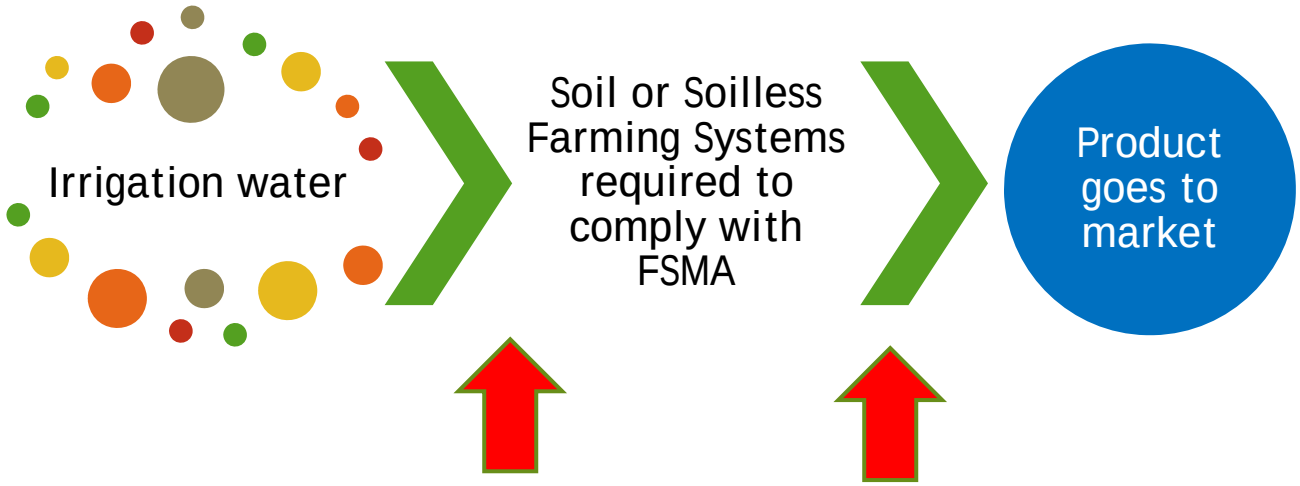
OBJECTIVE: Evaluate various pathogen reduction steps for soil and soilless farmers to consider when *E. coli* action thresholds are surpassed (non-contact irrigation water).

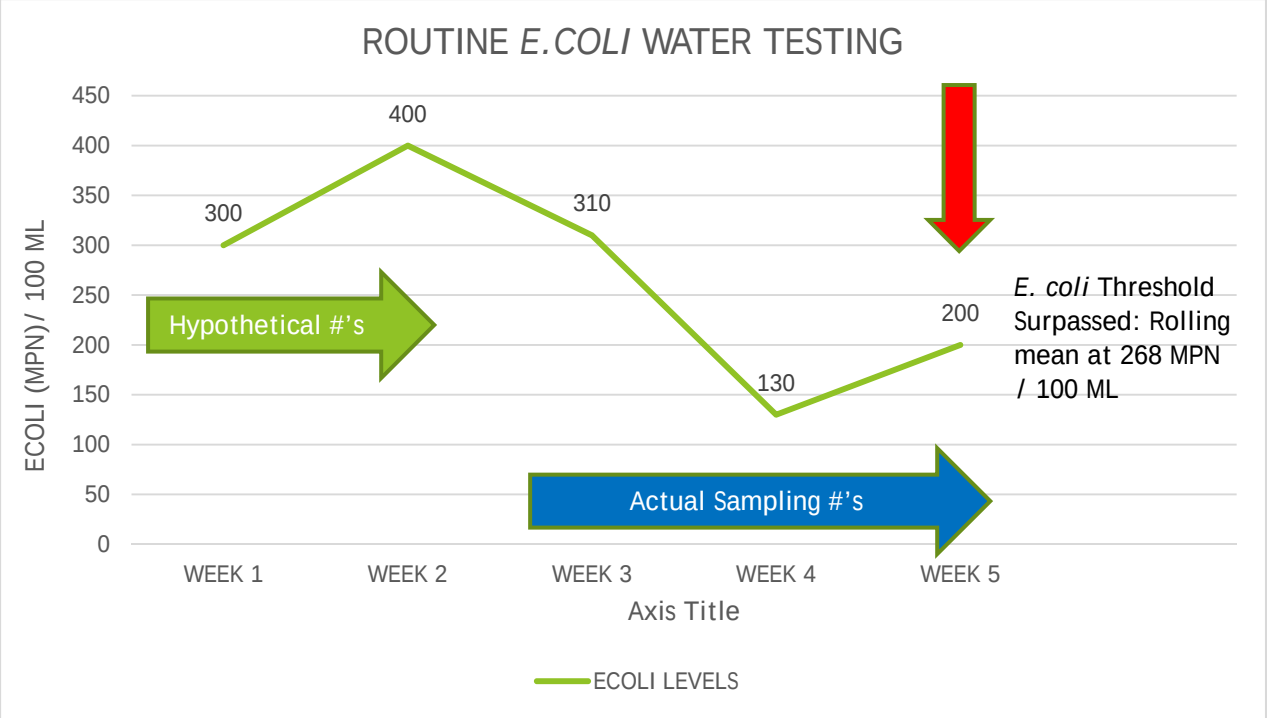


PATHOGEN REDUCTION STEP #1
If the rolling geometric mean (n=5) or any one sample exceeds the acceptance criteria, then the water shall not be used whereby edible portions of the crop are contacted by water until remedial actions have been completed and generic *E. coli* levels are within acceptance criteria:

≤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 (sand mimic filter)

Scenario #2: Chlorine 200 ppm with 2 in line filters

Scenario #3: Chlorine 400 ppm with 2 in line filters and 1 coffee filter

UV TREATMENT

Scenario #4: UV treated with 2 in line filters (120-175 micron)

AQUEOUS OZONE / UV TREATMENT

Scenario #5: Ozone treated with 2 in line filters (120-175 micron) FIRST then UV treatment

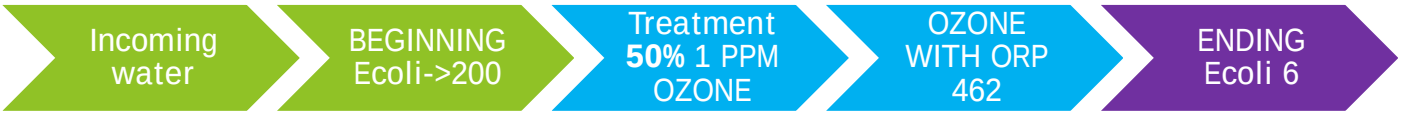
AQUEOUS OZONE TREATMENT: 1 HOUR UNIT

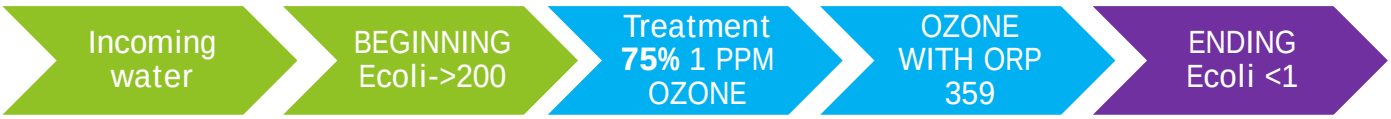
Scenario #6: Aqueous ozone mixed with irrigation water with 2 in line filters (120-175 micron)

BOD 5 day, EPA 405:1, MDL 1.0 mg/L: 2.5

Chemical Oxygen Demand: EPA 410:1, MDL 5.0 mg/L: 7.5

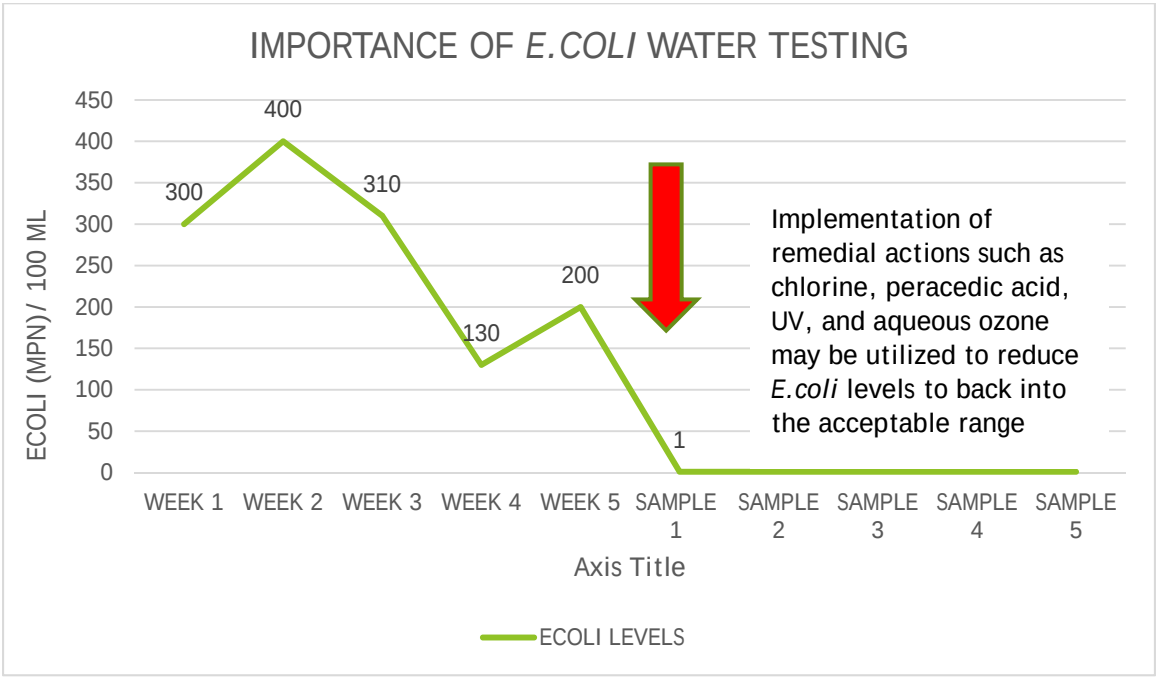
Total dissolved solids: EPA 160:1: MDL 1.0 mg/L: 68





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 ozone, UV, chlorine and peracetic acid to reduce the microbial activity of *E.coli* in irrigation waters. We feel 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 corrective measures have been completed and generic *E. coli* levels are back within the acceptance criteria range (non-contact acceptable range below):

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

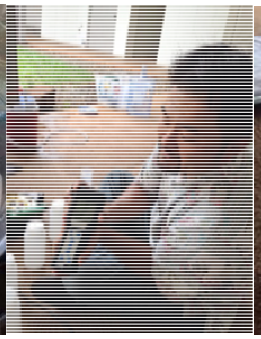
For specific information on treatment types or dosage options, please consult your local Extension agent or the HDOA food safety program.

OUR METHODOLOGY:



Irrigation water pumped into water containers with 2 inline filters. Used a 3rd coffee filter to mimic sand filter.






Calculated dosage and utilized chlorine strips, ORP and ATP meters to verify (and calibrate). Samples were submitted to the lab on the same day.



Aqueous ozone and UV system used.

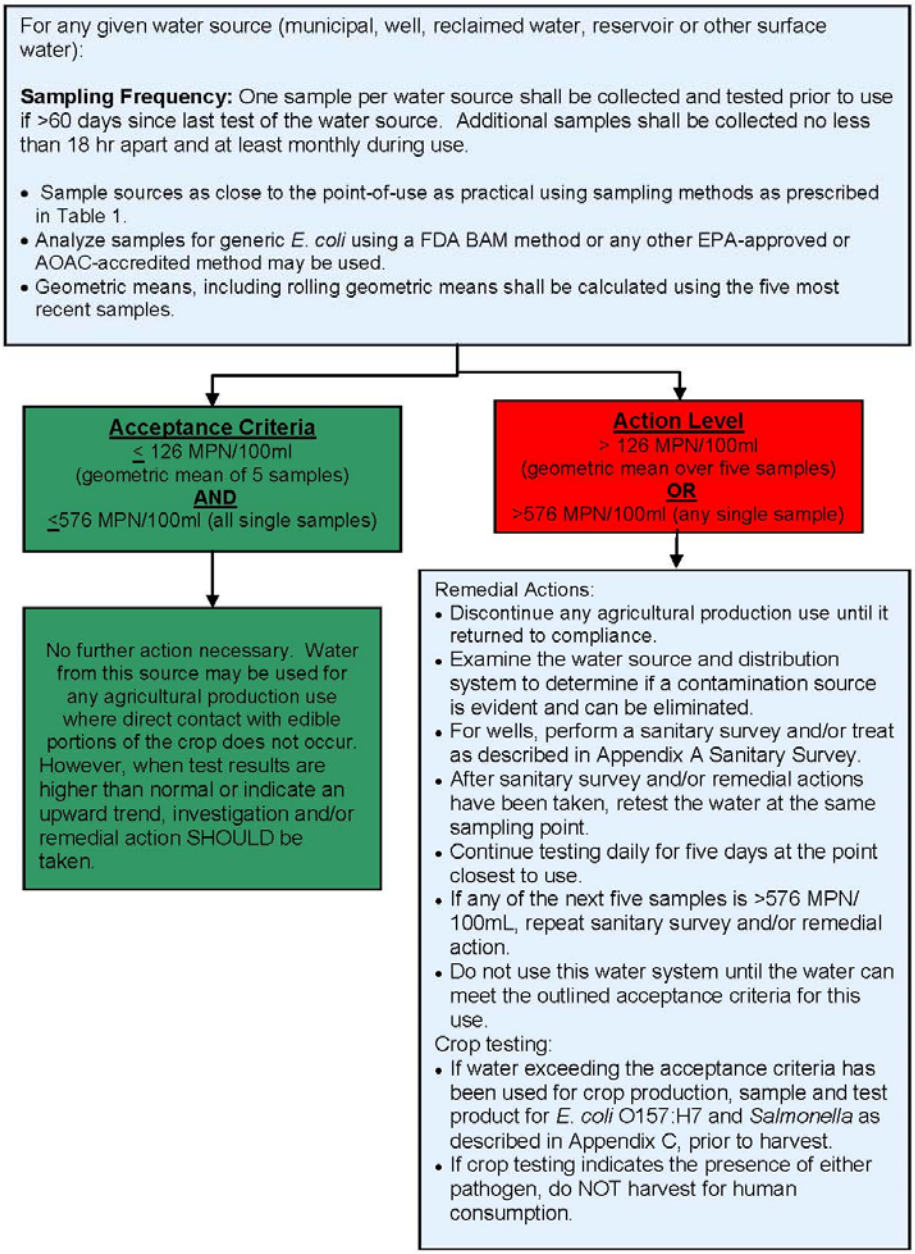
Special thanks to Senator Donovan Dela Cruz, Jimmy Nakatani (ADC), Fred Lau, Bradley Fox, Vincent Kimura (InnoviGreen), Sri Hartono (Hartono & Co, LLC), Dr. Koon Hui Wang, Jim Hollyer, East County Hawaii Farm Bureau for input and consultation.

Samples tested via an independent laboratory, Hawaii Food and Water Testing.

REFERENCES:

Example SOP, Extracted from the Commodity Specific Food Safety Guidelines for the Production and Harvest of Lettuce and Leafy Greens

Figure 1B. Decision Tree for PRE-HARVEST WATER USE – Non-Foliar Applications whereby edible portions of the crop are NOT contacted by water (e.g. furrow or drip irrigation, dust abatement water)



Calculating Rolling Geometeric Means

Water Requirements in the Proposed Produce Safety Rule of the Food Safety Modernization Act

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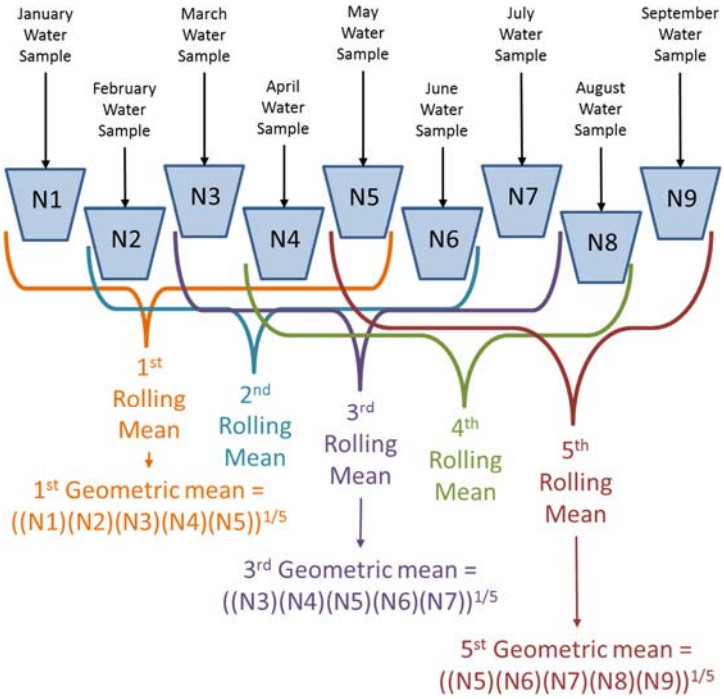

Figure 2. Agricultural Water – What is a Rolling Geometric Mean?