



Food Safety Basics for Produce Growers

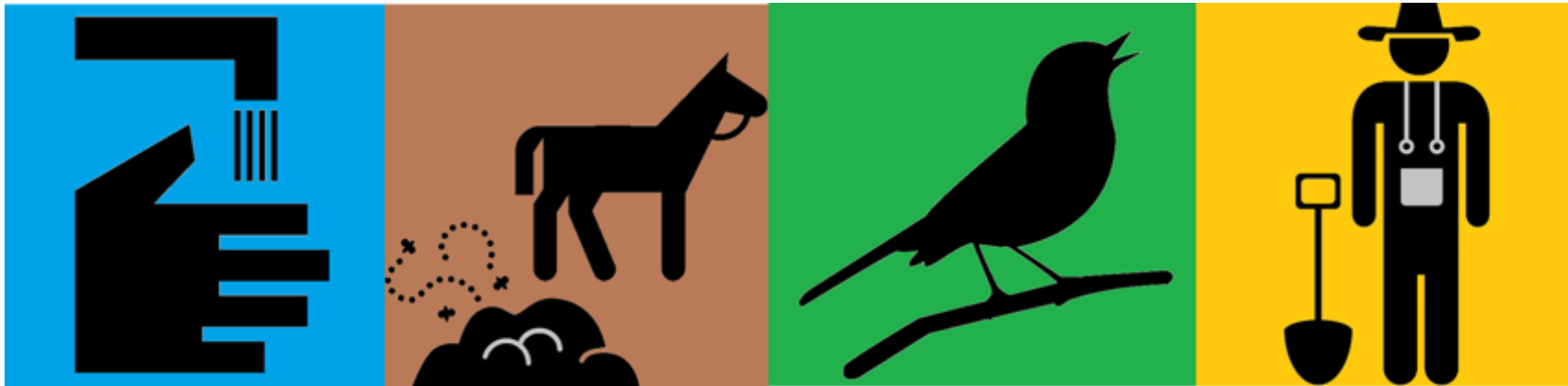


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Purdue University

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EA/EO

Produce Food Safety



Water

Waste

Wildlife

Workers

Why is this important?



Bacteria that Cause Foodborne Illness

The three most common bacteria associated with foodborne illness are:

Salmonella

E. coli O157:H7

Listeria monocytogenes

Bacteria Can Multiply Rapidly

1 Cell



24 hours under ideal growing conditions



17 Million Cells



Where are microbes found?

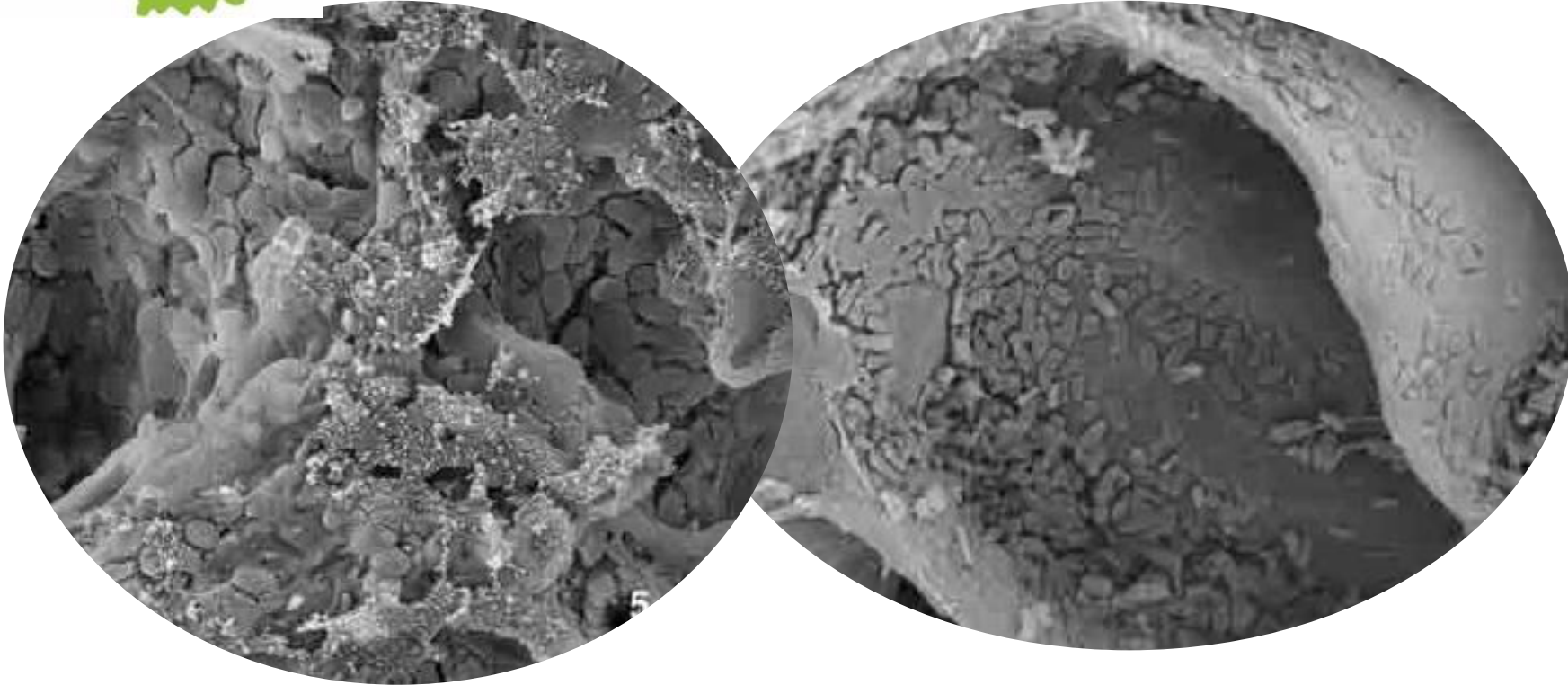
Soil
People
Water
Manure
Livestock
Pets
Wildlife



Photo credits:
Manure – S. Monroe
Irrigation – PSA
Bird - ?
Planters – Purdue
Hops Team

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Washing \neq Safe



Salmonella on muskmelon

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Washing \neq Safe



E. coli on lettuce

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Cooked vs. Raw Consumption

Fresh produce, by its very nature, is unprocessed.

There is not a kill step to reduce microbial populations prior to consumption!



Fresh Produce May be Contaminated:

In the field

At the wash/Pack

During cooling/Storage

During transportation

At the market

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Reduce On-Farm Risks by Using Good Agricultural Practices

Good agricultural practices (GAPs) are the conditions, growing practices, and harvesting practices recommended for **minimizing risk** of microbial contamination to produce.

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Benefits of GAPs for Your Farm

Improving public health

Extending shelf-life

Increasing quality

Performing due diligence

Reducing liability risk

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Steps to Food Safety on Your Produce Farm



1. GAPs Training
2. Farm Self-Assessment
3. Outline Food Safety Plan
4. Write Food Safety Plan
5. Implement Plan



Don't Forget to inform consumers of your on-farm food safety practices!

ALL growers who introduce produce into the public food supply should be concerned about food safety!



Photo Credits:
Packing line – Melon Acres, Inc.
Horse team – internet
Planters – Purdue Hops Team
Tractor – S. Monroe

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Prevention or Risk Reduction Falls into Four Broad Categories

Water



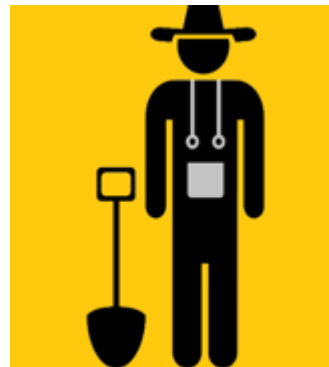
Wildlife

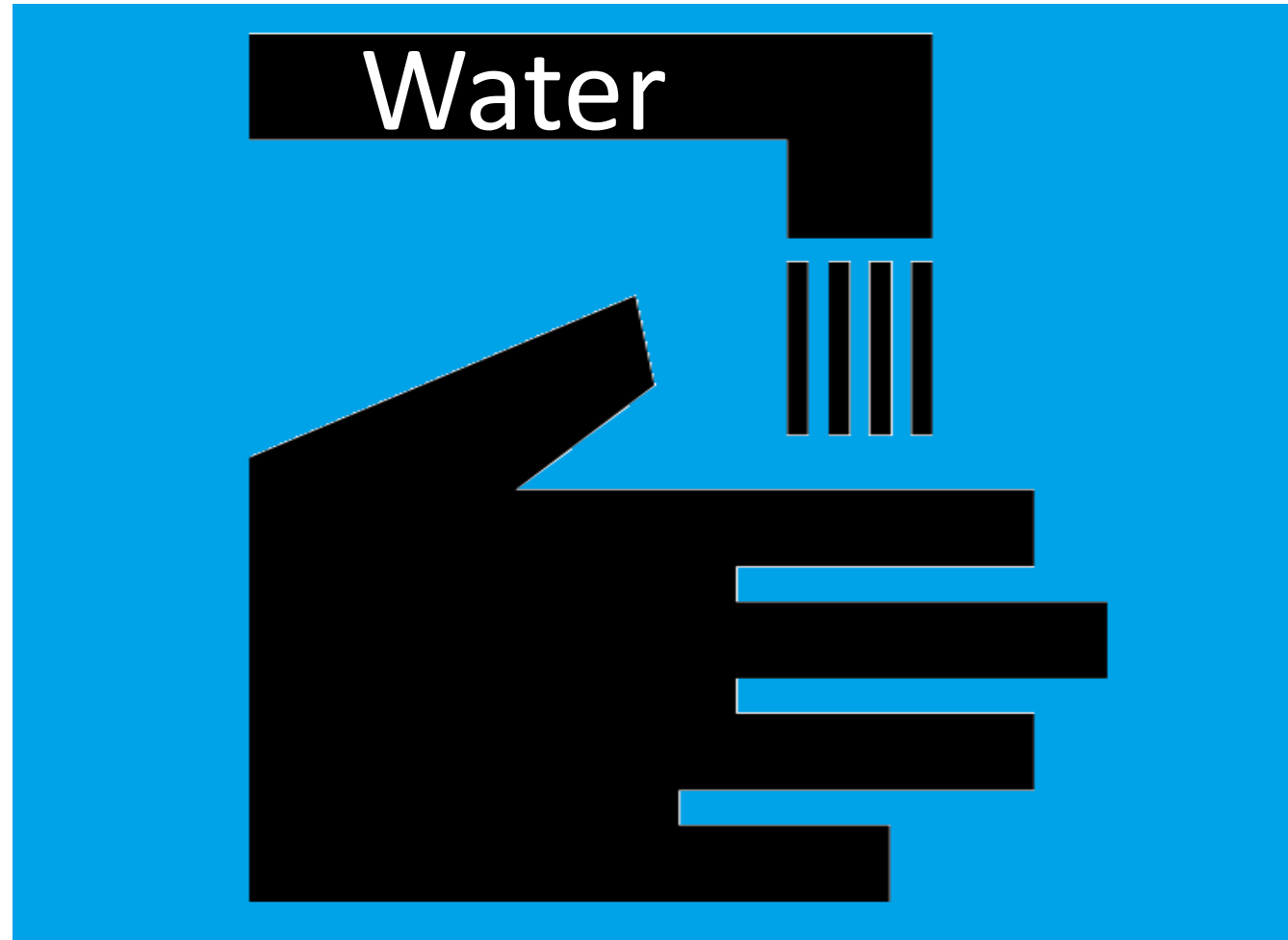


Waste



Workers





Water is the Major Source of Contamination for Fresh Fruits and Vegetables

Pathogens Found in Water Include:

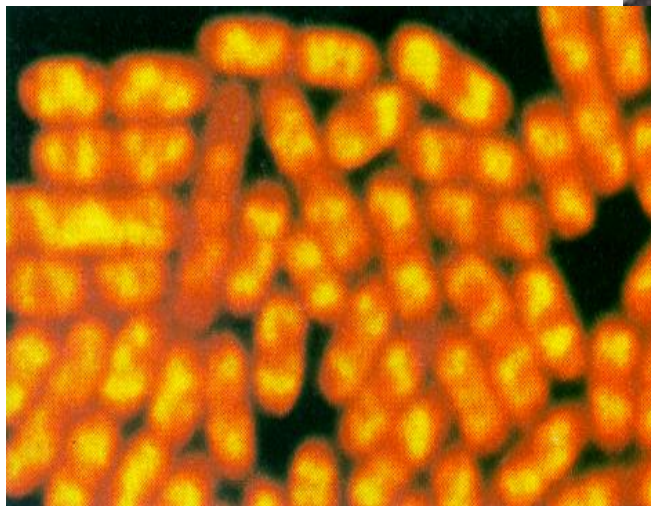
Escherichia coli

Salmonella spp.

Cryptosporidium parvum

Cyclospora cayetanensis

Salmonella



E. coli

Agricultural Water is used for...



Irrigation
Pesticide
application
Frost protection
Postharvest
Other...?

Water Sources

- Municipal and Rural Water systems
- Ground Water
 - Wells
 - Springs
- Surface Water
 - Ponds, Ditches, Streams, Rivers



Municipal Water Systems

- Least likely to be contaminated
- Legally must be potable
- Request copies of water quality tests at least annually



Protecting Wells

- Don't mix pesticides or other chemicals near the well
- Don't apply solid manure near well
- Use backflow prevention fittings when applying ag chemicals through irrigation system
- Retire and properly cap abandoned or unused wells
- Keep livestock away from active recharge area
- Inspect wells annually



Photo: elm**fertiligation_PPAC02MVC-056S_trim.jpg



Sealed Well

Managing the Wellhead Protection Area
<https://engineering.purdue.edu/SafeWater/wellhead/manage.htm>

Surface Water

- Most likely to be contaminated
- Run-off or wind-dispersal from animal facilities or compost operations
- Improperly treated sewage
- Wildlife



Protecting Surface Water

- Keep livestock out of water sources and drainages to water
- If manure is used, apply it away from surface water
- Manage manure storage and compost to avoid run-off
- Upgrade sewage systems



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Irrigation

Water contacting edible portion of crop near harvest poses the greatest risk

- Drip Irrigation

- Lower risk of contamination
- May not wet edible portion of crop
- Plastic mulch may reduce water or wet soil contact with crop

- Overhead Irrigation

- Higher risk of crop contamination
- Wets edible portion of crop



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Water Testing

Tests are used to track water quality,
not for daily monitoring

Records of test dates and results are
important to establish patterns

Change in pattern may indicate a
problem or possible fecal
contamination



Regular Testing is Recommended

Surface water

- Yearly before use

- Regularly during use (monthly)

- As required by regulation

Well water

- Yearly and before use or as required by regulation

Municipal water

- Yearly (obtain tests from water company)



Photo: S. Monroe

Where Do I Collect Samples?

- **Surface water and ground water:**
 - Take a representative sample appropriate for the water source
- **Municipal/public water supply:**
 - No sample required if testing reports obtained from the water utility, treatment plant, or lab
 - Optional sampling at different points in the distribution system can be useful



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How Do I Collect Samples?

- Follow all sample submission instructions from the laboratory
- A sterile bottle must be used to collect samples
- Do not rinse bottle before sampling
- In a distribution system, allow the water to run before sampling in order to collect a representative sample



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Collecting Water Samples

Sanitize spigot rim
Run water
Fill sample jar
Close
Timing of travel to lab?



Where Do I Go For Testing?

- Find a lab that is certified by state and local environmental agencies, or third-party accreditors
- Be certain the lab can provide the test you need
 - Quantitative analysis using Method 1603 (modified mTEC)
 - Upper limit of test high enough to measure your water quality and calculate profile statistics
- Be sure the lab provides sampling instructions
 - Labs should provide instructions for acceptable sampling containers, hold times, storing, and transport expectations



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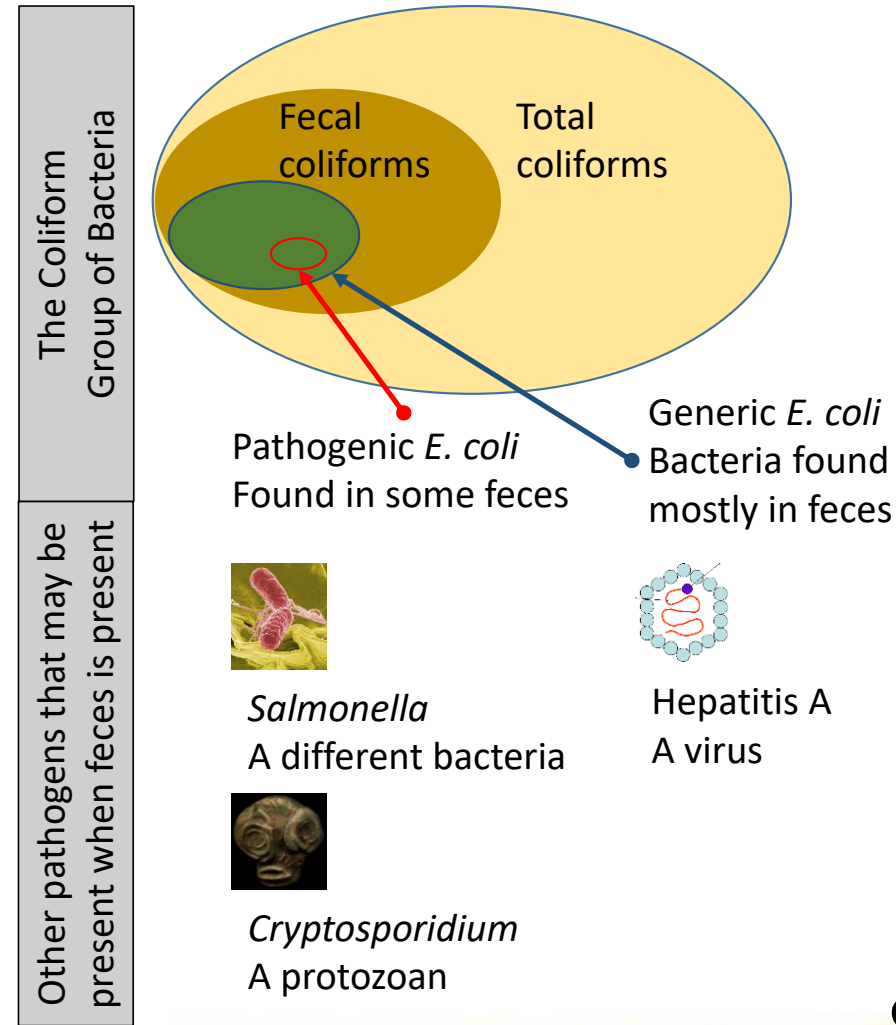
How are my samples tested?



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Generic *E. coli* is an Established Indicator

- Generic *Escherichia coli* (*E. coli*) is an indicator of fecal contamination
- *E. coli* is not a direct measure of the presence of human pathogens
- *E. coli* is the indicator used to measure water quality in the FSMA Produce Safety Rule



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Test Results

Water testing results are generally expressed as
Colony Forming Units per 100 ml Water
(CFU/100ml H₂O)

Test Results

Water that exceeds
126 CFU/100ml H₂O
is considered too contaminated
to use for production



What about bad water test results?

A bad test will NOT put you out of business!

A bad test merely indicates an additional risk factor to be mitigated

Corrective Measures (FSMA PSR)

- Three types of corrective measures are allowed if the microbial water quality profile does not meet water quality criteria:
 1. Apply a time interval for microbial die off
 - i. Between last application and harvest
 - ii. Between harvest and the end of storage and/or removal during activities such as commercial washing
 2. Re-inspect the water system, identify problems, and make necessary changes and confirm effectiveness
 3. Treat the water

What can be done?

Is it an on-going or repeated problem?

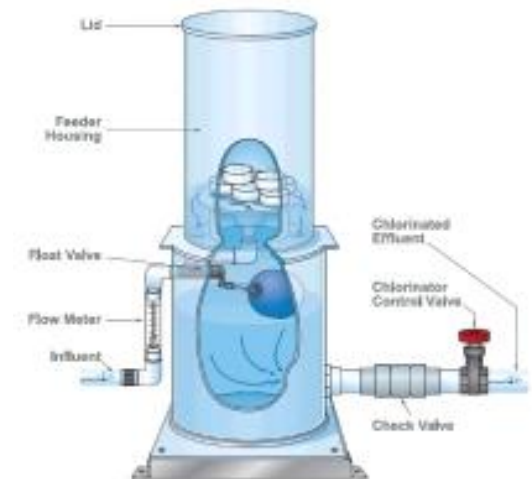
Well treatment

Chlorine treatment of wells may be an option
Check with state regulatory agencies for guidance.

Surface water treatment

Water may be treated (in-line) with chlorine
Labeled Peracetic Compounds also exist
(ex. SaniDate 12.0)

Find a new water source???



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Water Treatment

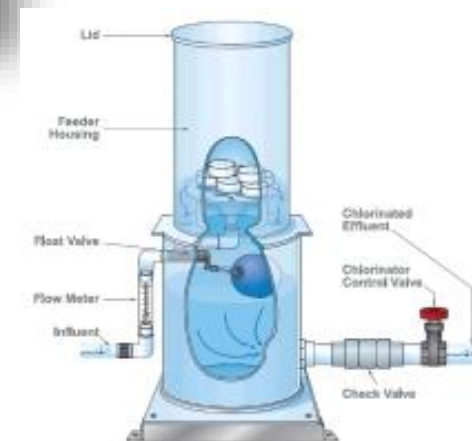
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Check with state regulatory agencies for guidance.

Surface water treatment

Water may be treated (in-line) with chlorine
Labeled Peracetic Compounds also exist
(ex. SaniDate 12.0)

Always use a labelled product and follow label directions!



Postharvest Water Uses

- Washing
- Hydrocooling
- Ice
- Flumes
- Dump tanks
- Hydration



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Postharvest Water Quality

All water that contacts the crop **after** harvest should meet EPA standards for microbial quality of drinking water (standards for potable water) at the start of the process.

**Zero Detectible
E. coli
per 100ml H₂O**



Water may infiltrate into produce

- If water is colder than the product, it is sucked in
- Pathogens enter with the water and may spread through the product
- Most likely when product is submerged in water



Photo: Wes Kline

Postharvest Water Quality

Postharvest water may be treated with a sanitizer if:

1. Water doesn't meet microbial standards.
2. Becomes contaminated during use.

A list of sanitizers registered in Indiana may be found at:

<https://ag.purdue.edu/hla/foodsafety/Pages/WashWaterSanitizers.aspx>

Common Postharvest Sanitizers

Chlorine
Peroxyacetic acid
Ozone
UV-C Illumination

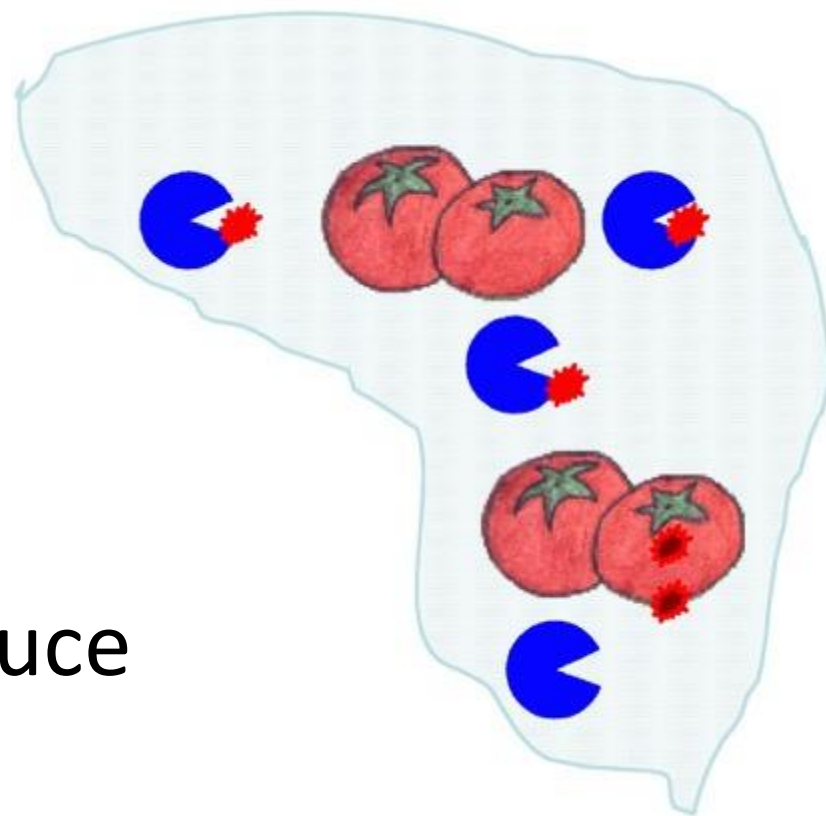
Source: Suslow, T. 1997. Postharvest chlorination. Pub. 8003, UC DANR. anrcatalog.ucdavis.edu/pdf/8003.pdf

What Sanitizers Do

Kill microbes in water

Kill microbes on surfaces

Prevent cross-contamination of produce



What Sanitizers Don't Do

Make dirty water clean

Kill all microbes equally effectively

Effectively manage biofilms

Sterilize the product or surface



Photo: W. Kline



Sanitizers Are Affected By:

Temperature

Turbidity

pH

If sanitizers are used, each must be monitored!

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Sanitizers are Regulated by EPA

The label is the law

- Uses
- Methods
- Rates
- Precautions
- Disposal

S AGCLOR 310

A solution of Sodium Hypochlorite for control of organisms causing decay of apple, asparagus, cabbage, carrots, cauliflower, celery, cherries, citrus, cucumber, lettuce, mushrooms, nectarines, peaches, pears, peppers, potatoes, prunes, quinces, and radishes after harvest.

P

ACTIVE INGREDIENT: Sodium hypochlorite 12.5%
INERT INGREDIENTS 87.5%
1.2 lbs Available Chlorine/Gallon

Net Contents: 55 Gallons (208 liters)
55 Gallons (208 liters)
53 Gallons (201 liters)

E

DANGER
KEEP OUT OF REACH OF CHILDREN

C

STATEMENT OF PRACTICAL TREATMENT

FIRST AID: In case of eye contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention. If contact with skin occurs, wash with plenty of soap and water. Remove contaminated clothing and shoes. Wash clothing before re-use.

IF SWALLOWED: Drink large quantities of water. Do NOT give vinegar or other acids. Do NOT induce vomiting. Get prompt medical attention. If inhaled, remove to fresh air.

See additional precautions on side panel.

EPA EST. NO.-s
8785-KY-1 550-SC-1
8785-FL-2 37862-WA-1
550-NJ-1 1744-CA-1

EPA REG. NO. 2792-62

PRECAUTIONARY STATEMENTS

I

M

E

N

WARNING: Lomative may cause severe skin irritation or chemical burns to broken skin. Causes eye damage. Do not get in eyes, on skin or clothing. Wear goggles or face shield and rubber gloves when handling this product. Wash thoroughly after handling. Remove and wash contaminated clothing promptly. Avoid breathing vapors and mist. Use with adequate ventilation. Vacate poorly ventilated areas as soon as possible. Do not return until odors have dissipated.

ENVIRONMENTAL HAZARDS: This pesticide is toxic to fish and aquatic organisms. Do not discharge effluent containing this product into lakes, streams, ponds, estuaries, oceans, or public waters unless this product is specially identified and addressed in an NPDES permit. Do not discharge effluent containing this product to sewer systems without previously notifying the sewage treatment plant authority. For guidance, contact your State Water Board or Regional Office of the EPA.

PHYSICAL AND CHEMICAL HAZARDS: STRONG OXIDIZING AGENT: Mix only with water according to label directions. Mixing this product with gases like feces, urine, etc., or with ammonia, acids, detergent, toilet bowl cleaners, rat removers, vinegar, or other chemicals may release hazardous gases irritating to eyes, lungs, and mucous membranes.

DIRECTIONS FOR USE:
NOTICE TO USER: It is a violation of Federal Law to use this product in a manner inconsistent with its labeling. This labeling must be in the possession of the user at the time of pesticide application.

STORAGE AND DISPOSAL: Agclor degrades with age. Storage at temperature above 70°F increases breakdown. Store in a cool, well-ventilated area away from direct sunlight.

In case of spill, flush with large quantities of water. Rinse empty container thoroughly with water and either return it to manufacturer or discard by placing in trash collection. Product or rinsate that cannot be used should be diluted with water and disposed of in a sanitary sewer. Do not contaminate food or feed by storage, disposal, or cleaning of equipment.

APPLICATION: For recommended concentration of available chlorine for various commodities to be treated see table on right panel. To obtain a 100-ppm solution of chlorine, add 0.175 gallons of AGCLOR to 1,000 gallons of water. Use of DECCO BUFFER 311 to control pH is highly recommended (100 gallons).

For other application rates, use appropriate dilutions.

Directions For Use continued on next panel.

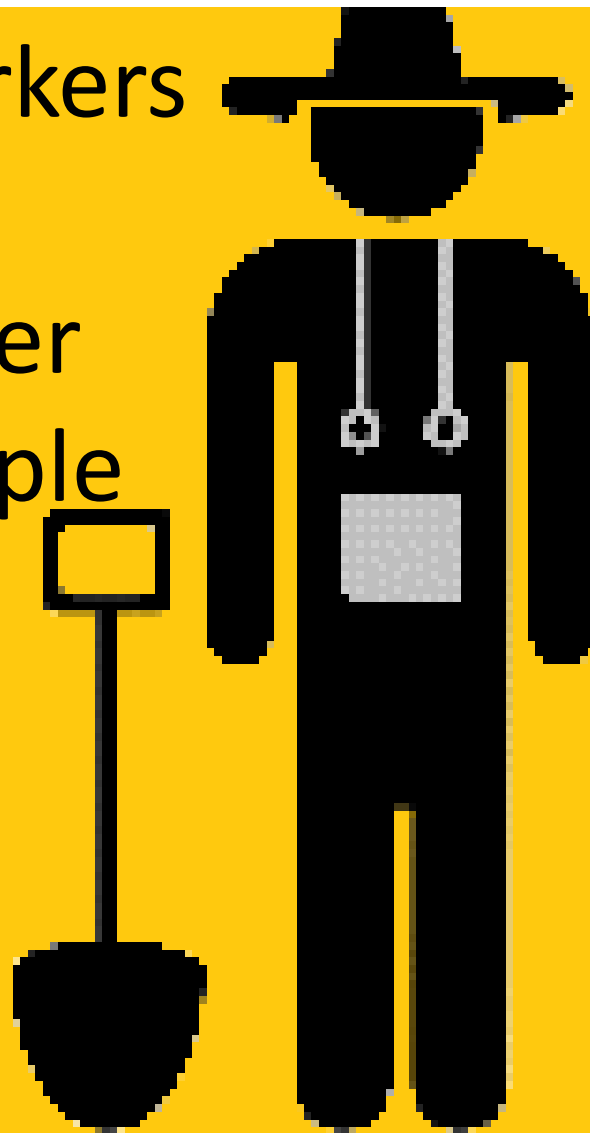


Let's play . . .

Do I Need a Sanitizer?

1. Washing radishes in a sink with running water from a faucet. Water is potable.
2. Wash line sprays water on peppers as they go by on a conveyor; water is not reused. Water is potable.
3. Lettuce is dunked in tubs of cold water; 1st tub removes most of dirt, 2nd tub removes the rest. Water is potable at start and reused for several batches.

Workers
and
Other
People





Poor worker health impacts farm safety

Poor health and hygiene can result
in the introduction of foodborne
pathogens into produce.

Workers Are A Food Safety Concern Because They...

- **Can carry human pathogens**
 - *Shigella*, Hepatitis A, Norovirus, and others
- **Can spread human pathogens**
 - Harvest and pack with their hands
 - Fecal-oral route
- **Require training to reduce risks**
 - Proper handwashing
 - How to handle illnesses and injuries



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Poor Hygiene

Poor hygiene on the
farm may include:

Improper handwashing
practices

Dirty restrooms

Hand sanitizer
CANNOT replace
proper handwashing!

Hand Washing



When Must Hands Be Washed?

After using the toilet

Before starting or returning to work

Before and after eating and smoking

Before putting on gloves

After touching animals or animal waste

Any other time hands may become contaminated



EA/EO

Steps to Sanitizing and Cleaning Anything



1. Pre-rinse

- Remove field soil, plant material, debris
- Scrape, brush, hose down, etc.

2. Wash

- Clean with a detergent solution
- Soil becomes dispersed in solution through chemical action, rubbing, scrubbing, etc.



3. Rinse

- Rinse away detergent solution and soil

4. Sanitize

- Mix sanitizer according to label, test
- Apply sanitizer as directed on label



Restrooms

Restrooms should be provided
for employees

Per OSHA, growers should have:

1 restroom for every 20 employees

Located no more than ¼ mile walk from work site

Cleaned regularly (and documented)



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Proper Use of Toilets

- All urination and defecation should be done in a toilet, NEVER in the field or nearby production areas
- Toilet paper should be deposited into the toilet, not in a garbage can or on the floor
- Always wash hands after using the toilet



EA/EO

Worker Clothing

- Clean clothes should be worn each day
- Footwear cleanliness is important
 - Designated footwear helps prevent cross-contamination
- Gloves, if worn, must be changed when they become contaminated or torn
 - If reusable gloves are used, clean often or as needed
- Aprons, gloves, and other food safety equipment should be removed before using the toilet and should be stored in a clean, designated area when not in use



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Worker Health

Everyone handling produce or working in fields should be monitored for signs of illness

**Sick workers
should **NOT**
handle produce**



EA/EO

Common Signs of Foodborne Illness

- Diarrhea
- Nausea
- Vomiting
- Abdominal cramps
- Fever/chills
- Muscle aches
- Headache



Photo: Produce Safety Alliance

EA/EO

Why would anyone go to work sick?

- May not have sick pay
- May not have sick leave
- May not health insurance
- May not have transportation to health care provider
- May need to get work done!

Worker Injury

- **Worker injuries may pose food safety risks**
 - A first aid kit should be available, stocked, and monitored
 - Clean and bandage all wounds
 - If the wound is on the hands, a glove should be worn to create a double barrier
 - Discard any produce that may be contaminated
 - Clean and sanitize any items that came in contact with bodily fluids
 - Report all injuries to supervisor



EA/EO

Worker Training

All workers should receive basic sanitation and hygiene training annually

Training is essential even if the workers are immediate family

Training doesn't have to be burdensome but **must be documented**



Photo: S. Monroe

EA/EO



Worker Training Should Include:

General information

1. Pathogens can be transported on produce
2. It is the responsibility of all workers to reduce risk

Basic health policies

1. Sick people don't handle produce
2. Procedure for reporting illness

Basic sanitation policies

1. How to wash hands
2. Restroom procedures
3. Management of injuries

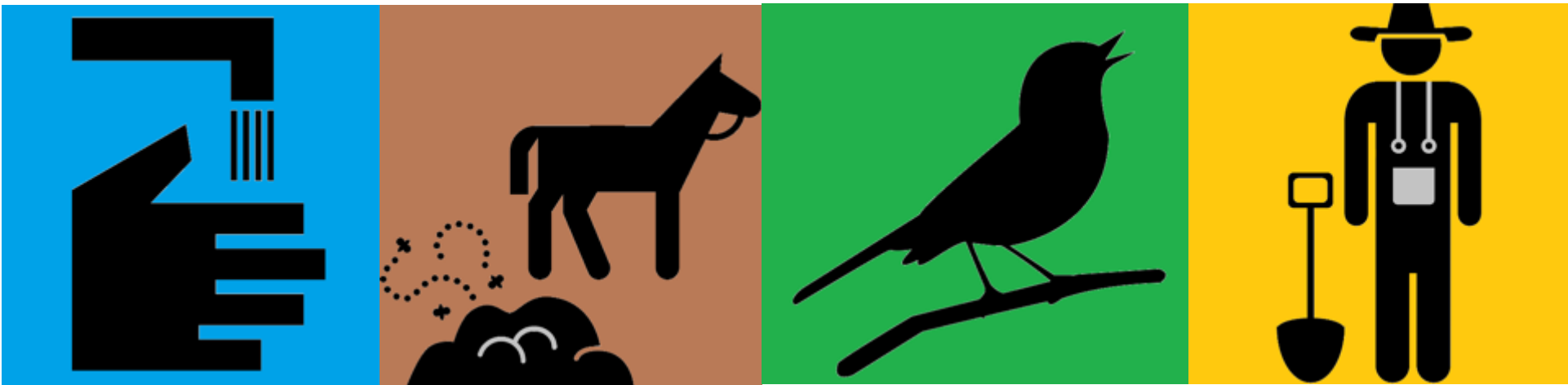
Farm-specific procedures

1. Location of facilities
2. Discipline policy

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Thank you

Questions?



EA/EO



GAPs Protocols

Various GAPs protocols (or audit schemes) are in use

All are similar, but not identical

USDA GAPs/GHPs

Harmonized GAPs

Global Food Safety Initiative (GFSI) Benchmarked

GlobalGAP

PrimusGFS

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