

Increasing Food Safety on the Farm with
Safe Agricultural Water

EXTENDING KNOWLEDGE >> CHANGING LIVES

NDSU

EXTENSION

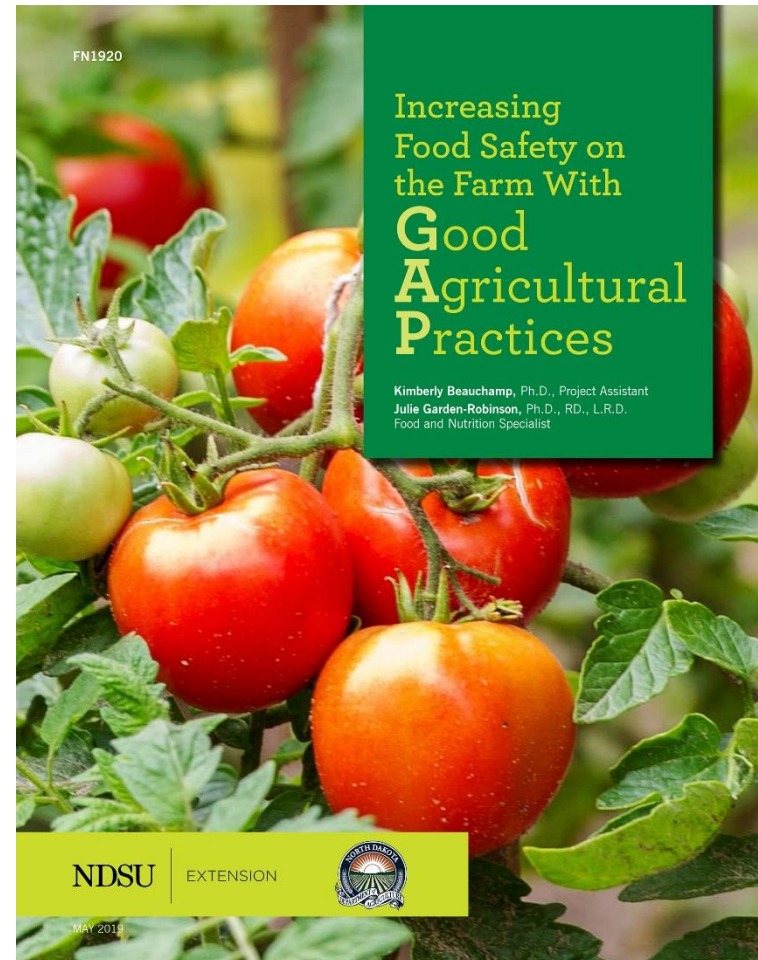


Introduction

This module is one of three self-paced learning tools designed to serve as an introduction to the information in the “Good Agricultural Practices” manual developed by NDSU Extension.

Development and production of the GAP manual was funded in part by the North Dakota Department of Agriculture.

Completing this module does not result in a certificate of course completion issued by the Produce Safety Alliance and the Association of Food and Drug Officials.



Acknowledgment



- This module was adapted from the Produce Safety Alliance Grower Training program and is used here with permission from Cornell University.
- Visit producesafetyalliance.cornell.edu for more information about training, including upcoming courses, to meet FSMA regulatory requirements.

Acknowledgment

This module is not a certification program. We encourage you to participate in face-to-face Produce Safety Alliance workshops for more in-depth information.

Instructions

- Please read through the information on the slides and in the notes.
- To view the notes: In the upper left corner of most slides, you will see a “speech bubble.” Mouse-over, click or right-click on the bubble to read additional material about the information on the slide.
- For more information about field-to-fork food safety, visit www.ag.ndsu.edu/fieldtofork and click on Good Agricultural Practices.
- Contact Julie Garden-Robinson at Julie.garden-robinson@ndsu.edu for more information

Pretest: On a piece of paper, answer these questions. The answers are at the end.

1. List these water sources in order of risk, from lowest to highest: Public water, surface water, ground water
2. List three methods of irrigation.
3. What type of bacteria is the indicator?
4. What three types of corrective measures are allowed if the microbial water quality profile does not meet water quality criteria?

After reading through this information, you will be able to:

- Identify risks that impact the microbial safety of water sources
- Describe practices such as water application method and timing that can reduce those risks
- Adopt practices that limit impacts to the environment, soil quality, and wildlife habitat
- Describe the importance of water testing
- Describe agricultural water quality criteria
- Describe actions that could be taken if agricultural water related risks are identified
- Identify records necessary to document agricultural water quality and use

Production Water Defined:

- Water used in contact with produce during growth
- Irrigation, fertigation, foliar sprays, frost protection



Agricultural Water Quality

- All **agricultural water** must be safe and of adequate sanitary quality for its intended use
 - Applies to water used for purposes outlined in both Parts I and II of this module



Production Water Concerns

- Many factors impact the quality of water
- Many sources and uses of water on the farm
- Human pathogens can be introduced into water and contaminate produce during growing activities

Produce safety is impacted by all of these things!



Production Water Uses Include:

- Irrigation
- Fertigation
- Crop sprays
- Cooling
- Frost protection
- Dust abatement
- Other uses where water directly contacts produce



Evaluating Risks Related to Production Water

Three main impact points for produce safety risks related to production water are:

1. Production water source and quality
 - Public water supply, ground water, surface water
 - Testing frequency and sampling location
2. Application method
 - Water that does not contact the harvestable portion
 - Water that contacts the harvestable portion of the crop
3. Timing of application
 - At planting or close to harvest

Probability of Contamination



Public Water Supply



Treated

Ground Water



Surface Water



Open to
Environment

Preventing Contamination of Water from Public Water Supplies

Public water supplies are treated to meet microbial drinking water standards, but distribution systems can introduce risks, therefore:

- Assess your connection to the public water supply and distribution system downstream
- Test the water if you have any concerns about the water source
- Have a back-up plan if you think water in the distribution system may be unsafe

Preventing Contamination of Ground Water Sources

- Inspect well to ensure it is in good condition
- Inspect wellhead to ensure it is properly capped and elevated
- Be sure land slopes away from wellhead to prevent runoff contamination into the well
- Install backflow prevention devices



Preventing Contamination of Surface Water Sources

- Assess nearby land use and upstream water activities to identify risks
 - Work with neighbors and local watershed groups to understand and minimize identified risks
- Assess and address runoff risks
 - Develop diversion ditches, berms or containments to minimize environmental runoff, runoff from manure and compost piles, or runoff from livestock feeding areas
- Monitor and control animal access to irrigation water sources where practical (e.g., irrigation reservoirs)

Methods of Irrigation

- Overhead (sprinkler)
 - Higher risk: A direct water application method resulting in contact with produce
- Flood (surface, furrow)
 - May avoid direct contact with produce
 - Consider risk of contact with contaminated soil during harvest or from splash
- Drip (trickle, subsurface, micro, under canopy)
 - Lower risk: Produce generally not in direct contact (except root crops), reduces foliar diseases, improves water use efficiency



Less Contact with Water = Lower Risk

A key question for evaluation of risk is:

“Is the water applied using a direct water application method?”

- If the answer is “never”, the risk from water is very low
- If the answer is “yes”, the type of commodity, quality of the water and the timing of the application should be reviewed to assess risks



Pathogens on Produce May Die Off Over Time

- Environmental conditions can influence die-off rates including
 - Desiccation (drying out)
 - Sunlight (ultraviolet irradiation)
 - Temperature and humidity
 - Starvation and competition
- Some pathogens may be ‘protected’ on the plant and survive for extended periods of time
- Under some conditions, pathogens can even regrow on a plant so avoiding contamination is best



Inspect Agricultural Water Sources and Water Distribution Systems

- Water can be contaminated at the source, or it can become contaminated in the distribution system
- Mapping all water distribution systems is recommended
- Water sources and distribution systems must be inspected at least annually
- Must keep water sources free of debris, trash, domesticated animals, and other hazards



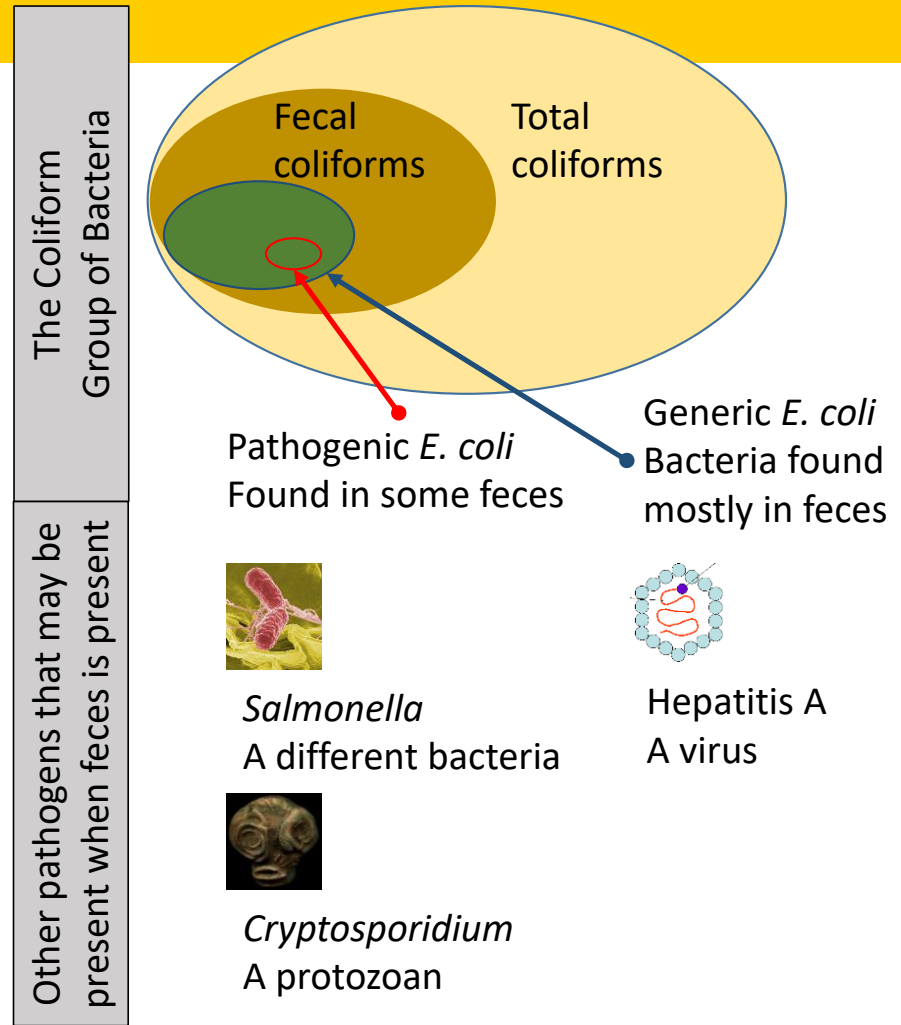
Evaluating Water Quality: Use of Microbial Water Quality Profiles

- Testing is the only way to quantitatively evaluate the microbial quality of the water
- The water quality profile can help you:
 - Understand the long-term quality of source water
 - Understand appropriate uses for each source
 - Determine if corrective measures are needed if the microbial water quality profile exceeds numerical GM and STV criteria in the FSMA Produce Safety Rule



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

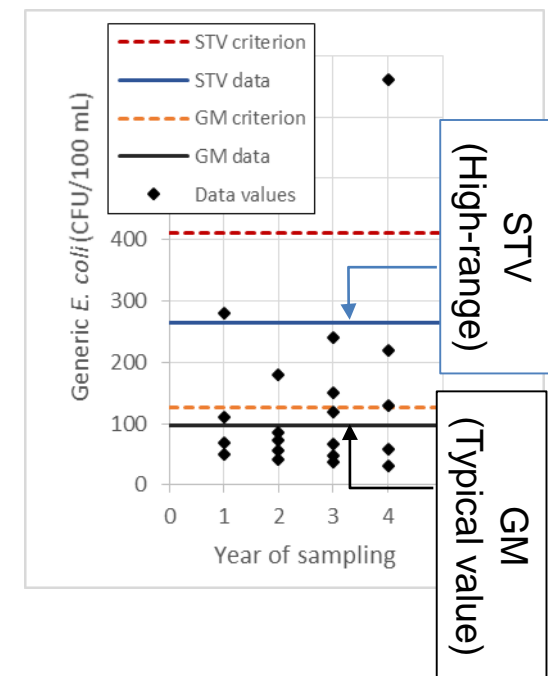


Water Quality Criteria for Water Used During Growing Activities

- Apply to water used with a direct water application method to covered produce
- Each source of production water must be tested to evaluate whether its water quality profile meets the following criteria:
 - **126 or less** colony forming units (CFU) generic *E. coli* per 100 mL water geometric mean (GM)
 - AND**
 - **410 or less** CFU generic *E. coli* per 100 mL water statistical threshold value (STV)

Geometric Means and Statistical Threshold Values

- Test results must be used to calculate Geometric Means and Statistical Threshold Values to compare to water quality criteria in the FSMA Produce Safety Rule
 - The geometric mean (GM) is a log-scale average, the “typical” value
 - The statistical threshold value (STV) is a measure of variability, the estimated “high range” value (approximated 90th percentile)
 - In the image to the right, both the GM and the STV values for the data meet criteria
- Tools are available to assist in calculating these values



Requirements for Public Water Sources

Source	Testing Requirement
Public Water Supply	Copy of test results or current certificates of compliance

- With appropriate documentation, there is no requirement to test water that meets the requirements for public water supplies.

Microbial Water Quality Profile: Survey of Ground Water Sources

Source	Initial and Annual Testing Requirement
Ground	4 or more times during the growing season or over the period of a year 1 or more samples rolled into profile every year after initial year

- Profile samples must be representative of use and must be collected as close in time as practicable to, but before, harvest

Microbial Water Quality Profile: Survey of Surface Water Sources

Source	Initial and Annual Testing Requirement
Surface	20 or more times over a period of 2 to 4 years 5 or more samples rolled into profile every year after initial survey

- Profile samples must be representative of use and must be collected as close in time as practicable to, but before, harvest

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



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



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

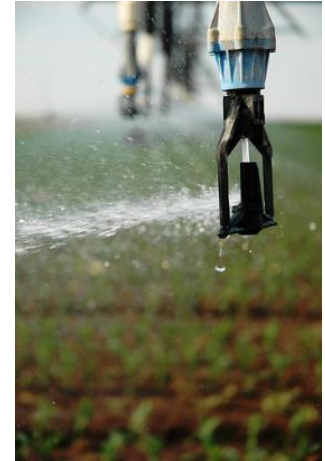


Corrective Measures

- 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

Corrective Measure: Water Application and Timing

- Risks from production water may be reduced by maximizing the time between last application and harvest
- One option for a corrective measure is to use a microbial die-off rate of 0.5 log per day between last application and harvest for up to four consecutive days



Corrective Measure: Re-Inspection and Corrective Actions

- If there is a problem with your water, be cautious until you know more!
- Re-inspect water system for contamination sources
 - Manure runoff, migratory birds, septic tank leaching
- Use corrective actions that address contamination sources under your control
 - Keep in mind state, county, and federal regulations
- Implement strategies to prevent contamination from happening
- Confirm that the changes were effective



Corrective Measure: Treating Production Water

- Any chemicals used to treat water must be EPA registered and labeled for intended use
- Non-chemical treatments, called pesticide devices by EPA, may be used if they adequately reduce microbial risks
 - Filter units, UV light units, ozonator units
- You should avoid water treatments that may have negative environmental and soil quality impacts
- You must keep records of all treatment monitoring done

Corrective Actions Needed? Unintentional Water Contact

- Broken Emitters and Other Water Application Issues
 - What is known about the quality of the water? How close is harvest?
- Human Mistakes
 - Spray applications accidentally mixed with untreated surface water
 - Forgetting to turn off irrigation pumps, may result in in-field flooding
- Flood Events
 - If the produce has come in contact with flood water from overflowing streams or open bodies of water, it is considered adulterated by the FDA and cannot be used for food
 - Contact with flood water that is not part of a natural disaster may be subject to provisions of the FSMA Produce Safety Rule



Recordkeeping

- Keep required records such as:
 - Findings of the inspection of water system
 - Water test results
 - Monitoring of water treatments
 - Corrective measures taken, if any
 - Scientific data or information to support compliance including treatment, calculations, and testing
 - Scientific data or information to support alternative indicators, criteria, or sampling frequencies

Summary

- Contaminated agricultural water has been implicated in some foodborne outbreaks associated with fresh produce
- Knowing the water quality through long-term testing will help establish management practices for appropriate use of the water
- If the water IS NOT applied by a direct application method to the harvestable portion of the crop, the risks are lower
- Extend time between last application of water and harvest to reduce risks, if water quality is a concern
- Treating water is an option to reduce risks
- Keep copies of all water test results
- Document all water management practices

Answer

1. List these water sources in order of risk, from lowest to highest: Public water, surface water, ground water

Public water (lowest risk)

Ground water

Surface water (highest risk)

Answer

2. List three methods of irrigation.

a) Overhead (sprinkler)

- Higher risk: A direct water application method resulting in contact with produce

b) Flood (surface, furrow)

- May avoid direct contact with produce
- Consider risk of contact with contaminated soil during harvest or from splash

c) Drip (trickle, subsurface, micro, under canopy)

- Lower risk: Produce generally not in direct contact (except root crops), reduces foliar diseases, improves water use efficiency

Answer

1. What type of bacteria is used as the indicator?

Generic *Escherichia coli* (*E. coli*) is an indicator of fecal contamination

Answer

4. What three types of corrective measures are allowed if the microbial water quality profile does not meet water quality criteria?

- a) Apply a time interval for microbial die off
- b) Re-inspect the water system, identify problems, and make necessary changes and confirm effectiveness
- c) Treat the water

Improving Food Safety with
Safe Agricultural Water

EXTENDING KNOWLEDGE >> CHANGING LIVES

NDSU

EXTENSION