Microbial Water Quality and Fresh Market Vegetables

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My Agenda

- Foodborne illness in the US
- FSMA and how it might impact you
- Produce Safety Rule - ”covered” produce and “agricultural water”
- Microbial quality of agricultural water
- Produce safety research at OSU – past, current, and upcoming
- How you can help us
- How we can help you

Foodborne illness in the US

- 48 million cases of foodborne illness in the US annually
- 128,000 hospitalizations
- 3,000 deaths

- Changing populations with increased susceptibility
  - 30% of US population is especially “at risk”

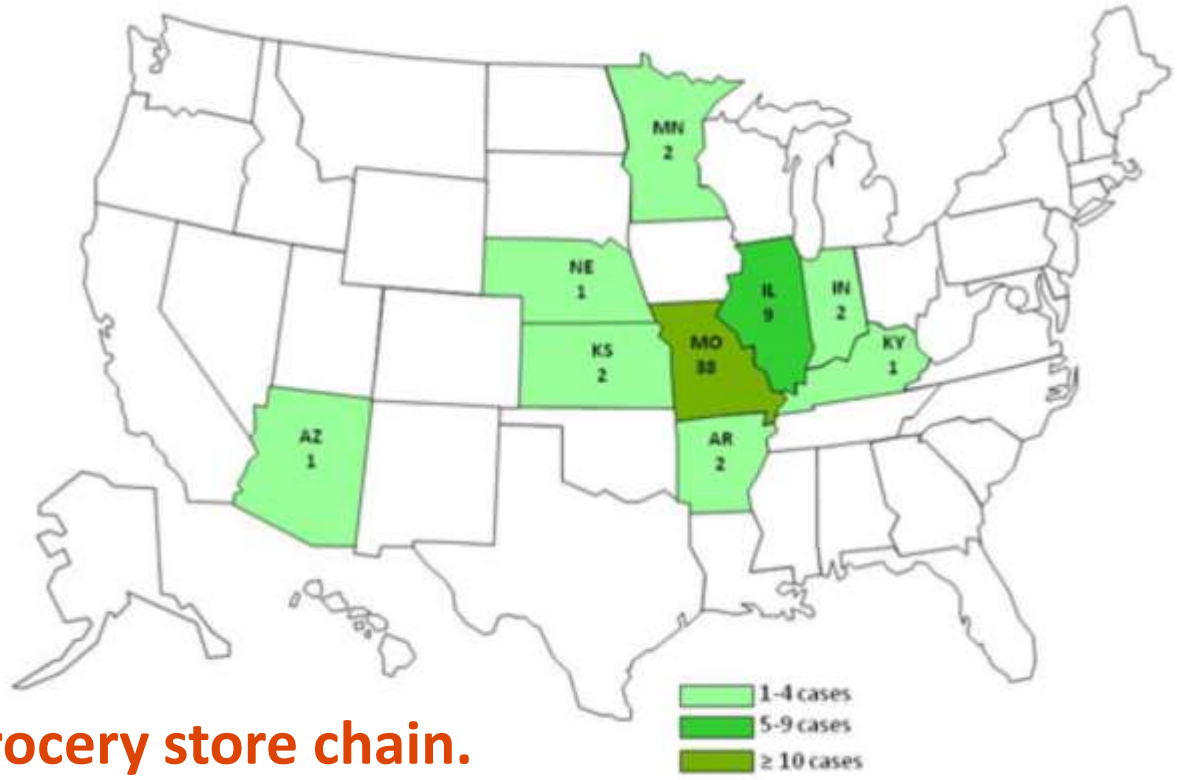
- Foodborne illnesses are not always simple stomachaches.

Example of Fresh Produce Contamination, 2011

Multistate Outbreak of *E. coli* O157:H7 Infections Linked to Romaine Lettuce

At a Glance:

- Case Count: 58
- States: 9
- Deaths: 0
- Hospitalizations: 33
- Recall: Yes



Illnesses traced to salad bar at a single grocery store chain.
Further investigation identified a single farm as the source.
Source on farm not identified.

Example within the Pacific Northwest, 2016

Multistate Outbreak of Listeriosis Linked to Frozen Vegetables

At a Glance:

- Case Count: 9
- States: 4
- Deaths: 3
- Hospitalizations: 9
- Recall: Yes

11 SKUs initially recalled.
Further investigation led to ~400 SKUs recalled
All product processed from May 2014-June 2016

Why FSMA and how it is designed to help?

- Globalization
  - 15% of US food supply is imported
- New Foods and Production Processes
  - More foods in marketplace
  - New hazards
  - Processes with unknown efficacy

- Broad <u>prevention</u> mandate with accountability
- Responsibility for food safety goals from farm-to-table
- Partnerships and responsibility across the food system

Food Safety Modernization Act (FSMA)

- **7 Major Rules**
  - Accredited third-party certification
  - Foreign supplier verification programs (FSVP) for importers of food for humans and animals
  - Mitigation strategies to protect food against intentional adulteration
  - Sanitary transportation of human and animal food
  - Preventive controls for food for animals
  - **Preventive controls for human food**
  - **Standards for produce safety****

Farm-to-Table Prevention and Control

Major focus of these rules is on microbial food safety; however, chemical and physical hazards are also important.

The rule provides an exemption for produce that receives commercial processing that **adequately reduces** the presence of microorganisms of public health significance, under certain conditions.

Business Size	Compliance Dates for Sprouts	Compliance Dates For Most Produce	Water Related Compliance Dates[1]	Compliance Date for Qualified Exemption Labeling Requirement [2]	Compliance Date for Retention of Records Supporting a Qualified Exemption
All other businesses (>$500K)	1/26/17	1/26/18	1/26/22	1/1/2020	1/26/16
Small businesses (>$250K-500K)[3]	1/26/18	1/28/19	1/26/23		
Very small businesses (>$25K-250K)[4]	1/28/19	1/27/20	1/26/24		

[1] According to the Proposed Rule issued 9/13/17, Compliance dates for Subpart E, Agricultural Water, allow an additional four years.
[2] A farm eligible for a qualified exemption must notify consumers as to the complete business address of the farm where the food is grown, harvested, packed, and held. [3] A farm is a small business if, on a rolling basis, the average annual monetary value of produce sold during the previous 3-year period is no more than $500,000.
[4] A farm is a very small business if, on a rolling basis, the average annual monetary value of produce sold during the previous 3-year period is no more than $250,000.

Training Requirements

Before the compliance date, every covered farm that does not qualify for an exemption must have a supervisor (such as a farm owner/ operator) complete a standardized food safety training program. You can find out more about food safety training from the Produce Safety Alliance. https://producesafetyalliance.cornell.edu/training

Revised 10/09/17

Produce Safety ALLIANCE

SC Southern Center for Training, Education, Extension, Outreach, and Technical Assistance to Enhance Produce Safety

The Produce Safety Rule:

Standards for the Growing, Harvesting, Packing, and Holding of Produce for Human Consumption

- Key Requirements:
  - Agricultural Water – FDA is considering modifications to simplify rule
  - Biological Soil Amendments
  - Domesticated and Wild Animals
  - Worker Training and Health and Hygiene
  - Equipment, Tools, and Buildings

- Applies to produce that is consumed raw **OR** that is not processed with a validated kill step.

Do you grow, harvest, pack, or hold "covered" produce?

Examples of "covered" produce = consumed raw:

- Onions
- Sweet Cherries
- Blueberries
- Blackberries
- Plums
- Walnuts
- Marionberries
- Cabbage
- Broccoli
- Kale

Not Covered Produce (not subject to the rule) = rarely consumed raw – List is <u>Exhaustive</u>

Asparagus, Beans (black, great Northern, kidney, lima, nay, pinto), garden beets (roots & tops), cashews, sour cherries, chickpeas, cocoa beans, coffee beans, collards, sweet corn, cranberries, dates, dill (seeds & weed), eggplants, figs, ginger, hazelnuts, horseradish, lentils, okra, peanuts, pecans, peppermint, potatoes, pumpkins, winter squash, sweet potatoes, water chestnuts

Rule does not apply to:

- Food grains

Are you excluded or exempted from the rule?

- Exclusions:
  - Personal or on-farm consumption
  - Farms with <25,000 average annual value of produce sales (3 years)
- Qualified Exemptions (modified requirements):
  - Farm must have <$500,000 in average annual food sales (3 years)
  - **AND**
  - Sales to qualified end users must be >50% of sales
    - Qualified end users:
      - Consumer
      - Restaurant or retail food establishment in same state or Indian reservation as farm or <275 miles away
  - Label produce with name and address of farm and some documentation.
  - Exemption withdrawn if outbreak or investigation occurs.

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Do you apply any water to your “covered” produce?

Agricultural water: water intended to, or likely to, contact the harvestable portion of the crop or food-contact surfaces.

Is this Agricultural Water?

Lettuce

Overhead irrigation, Pond water

SUPPLEMENTAL MATERIAL

Is this Agricultural Water?

Citrus

Drip irrigation, Surface water

SUPPLEMENTAL MATERIAL

Is this Agricultural Water?

Apples

Pesticide application, Well water

SUPPLEMENTAL MATERIAL

Is this Agricultural Water?

Potatoes

Overhead Irrigation, Surface water

SUPPLEMENTAL MATERIAL

Is this Agricultural Water?

Carrots

Drip irrigation, surface water

SUPPLEMENTAL MATERIAL

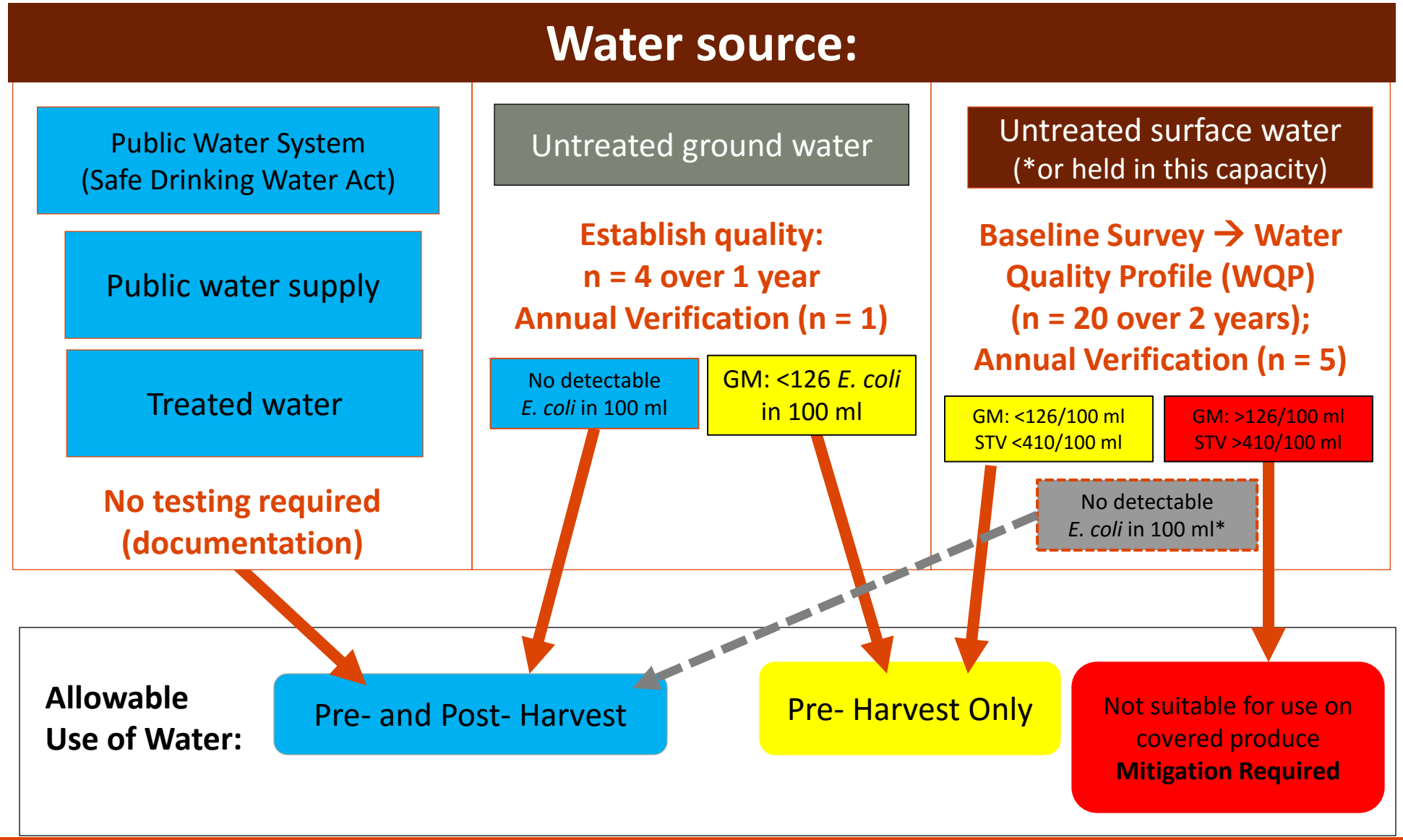
Microbiological water quality requirements for “covered” produce

Pre-Harvest Activities	Harvest Activities	Post-Harvest Activities
Irrigation	Direct contact	Direct contact
Overhead cooling, etc.	Food-contact surface contact	Food-contact surface contact
Sprout Irrigation	Ice contacting food-contact surfaces	Ice contacting food-contact surfaces
Treated Agricultural Tea	Hand washing	Hand washing

Low levels of generic *E. coli* allowed 112.44(c)

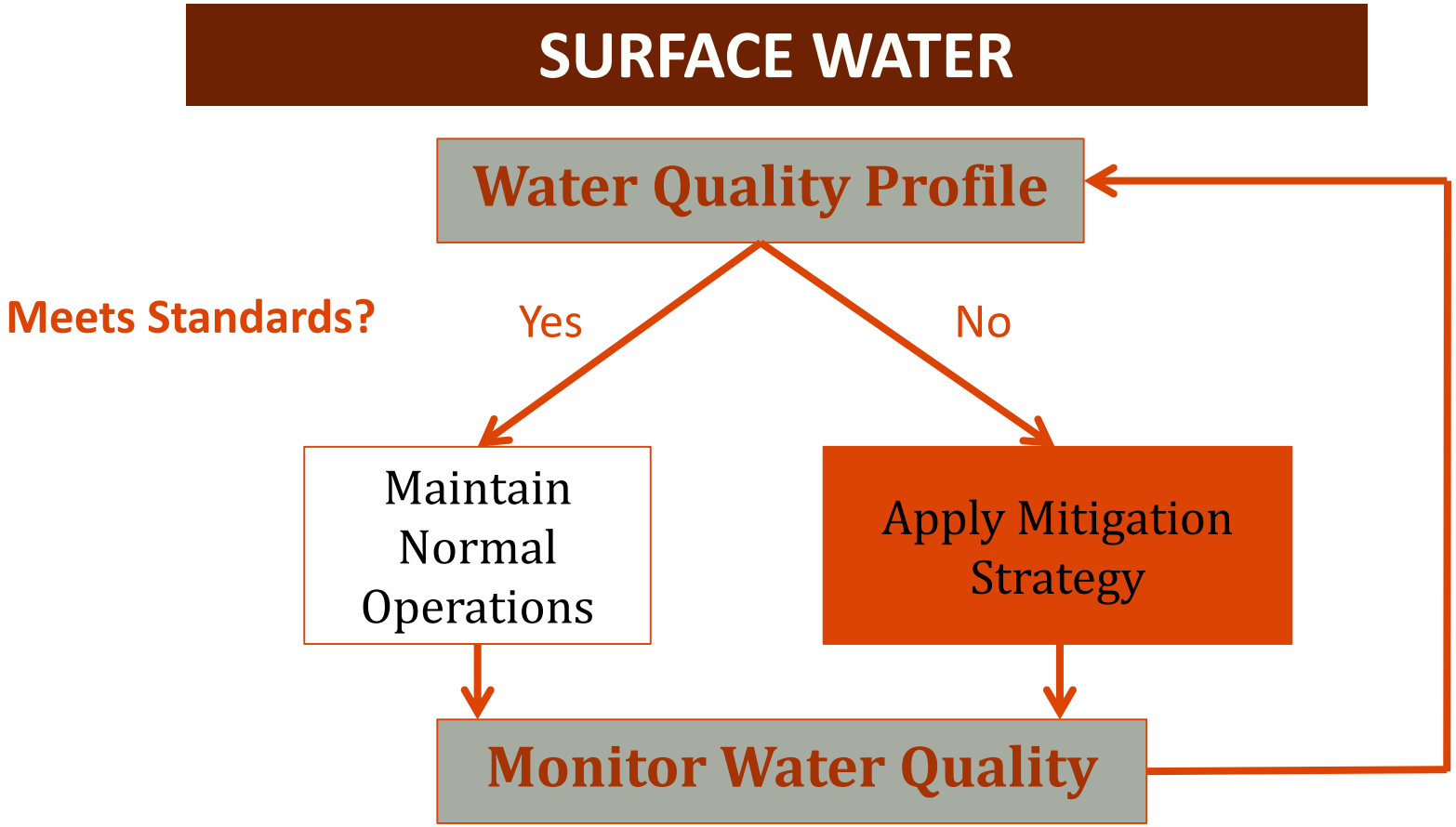
No detectable generic *E. coli*/100 ml water 112.44(a)

Overview of Microbial Water Quality Standards (112.44 and 112.45)



Surface Water Testing Decision Tree

Covered Produce AND Direct Application



Apply Mitigation Strategy:

Goal: Provide same level of public health protection as using irrigation water that met the standard

Time Interval Between Irrigation and Harvest

- **0.5 log reduction per day (up to 4 days)**
- Alternative data – research needed

Time Interval Between Irrigation and End of Storage

- Supporting data – research needed
- Recordkeeping

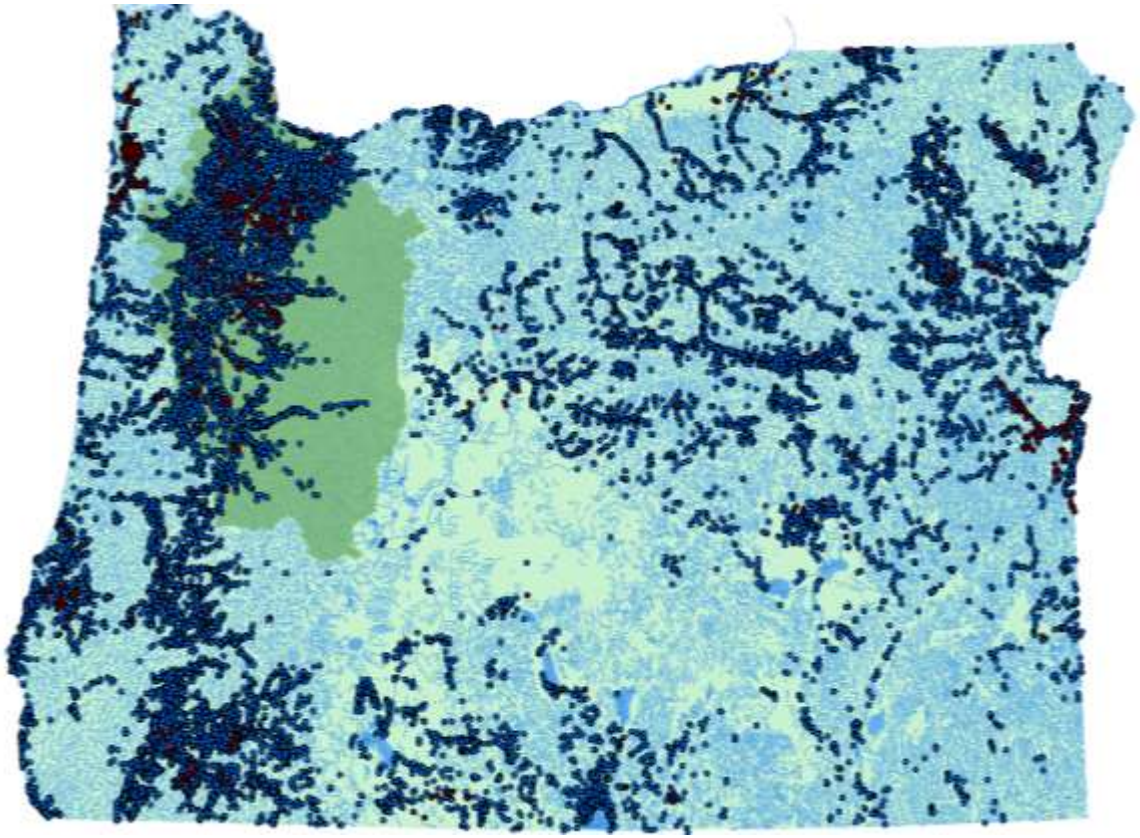
Treat Water

- Supporting data – research needed
- Recordkeeping

Discontinue Use

- Inspect
- Make changes
- Retest

Moving forward with agricultural water



FDA is reconsidering the water testing requirements section of the Produce Safety Rule

- Water compliance dates have been delayed
- No timeline on when there will be more information/guidance

Surveys and research to identify highest risk for prioritizing investments in mitigation strategies

Assist stakeholders with compliance

Produce Safety Research

We need your help!

Previous, current, and upcoming research and training opportunities

Previous Research

Greenhouse research funded by the Western Center for Food Safety and the Center for Produce Safety.
Field research was funded by the Oregon Specialty Crop Block Grant Program.

Microbial Die-Off in Onions Produced with Contaminated Irrigation Water: Greenhouse and Field Studies

Day 19
April 10

Day 27
April 18

Day 54
May 15

Day 75
June 5

Day 117
July 17

Day 129
July 30

Work conducted in collaboration with Drs. Clint Shock and Stuart Reitz at Malheur County Experiment Station

Oregon State University

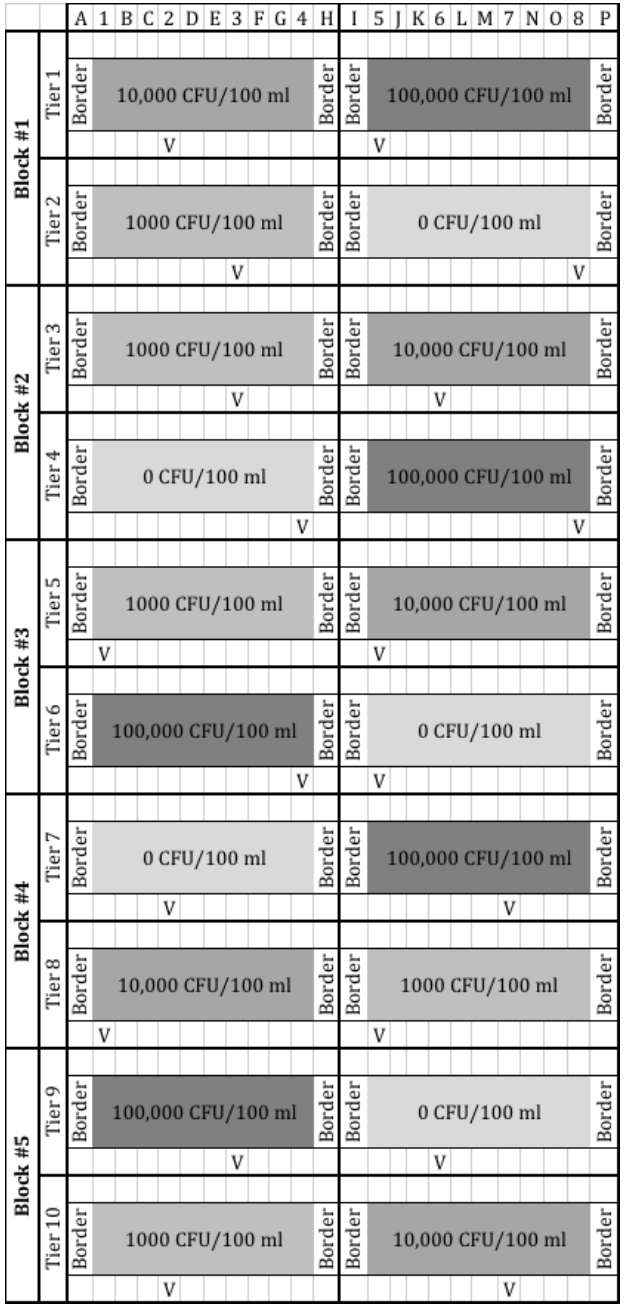
Research Question

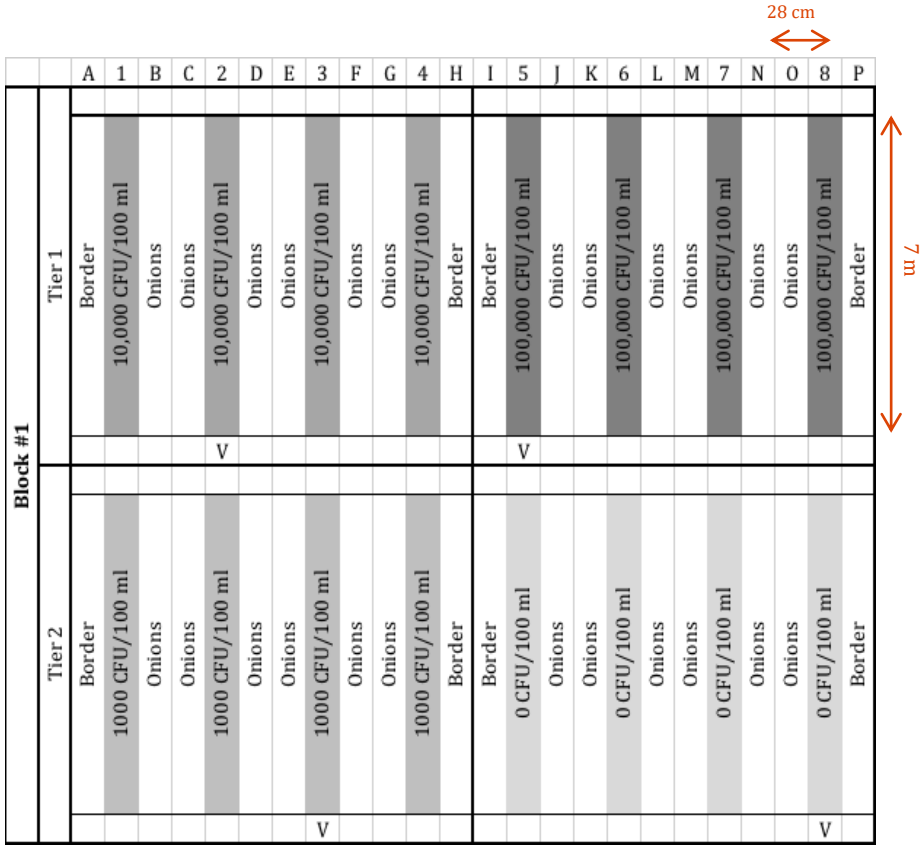
Do finishing practices used by the onion industry mitigate any potential risk associated with poor water quality?

- Treasure Valley is a major producer of dry bulb onions.
- Dry bulb onions are the only “covered” produce grown in Treasure Valley, but it is the highest value crop.
- No confidence that they could meet water quality standards of produce rule.
- Conventional practices provide a long period between last irrigation and harvest (4 weeks).

- Approach: Conduct a field trial with irrigation water contaminated with various levels of generic *E. coli* on the last irrigation and evaluate onion bulbs for contamination throughout finishing.

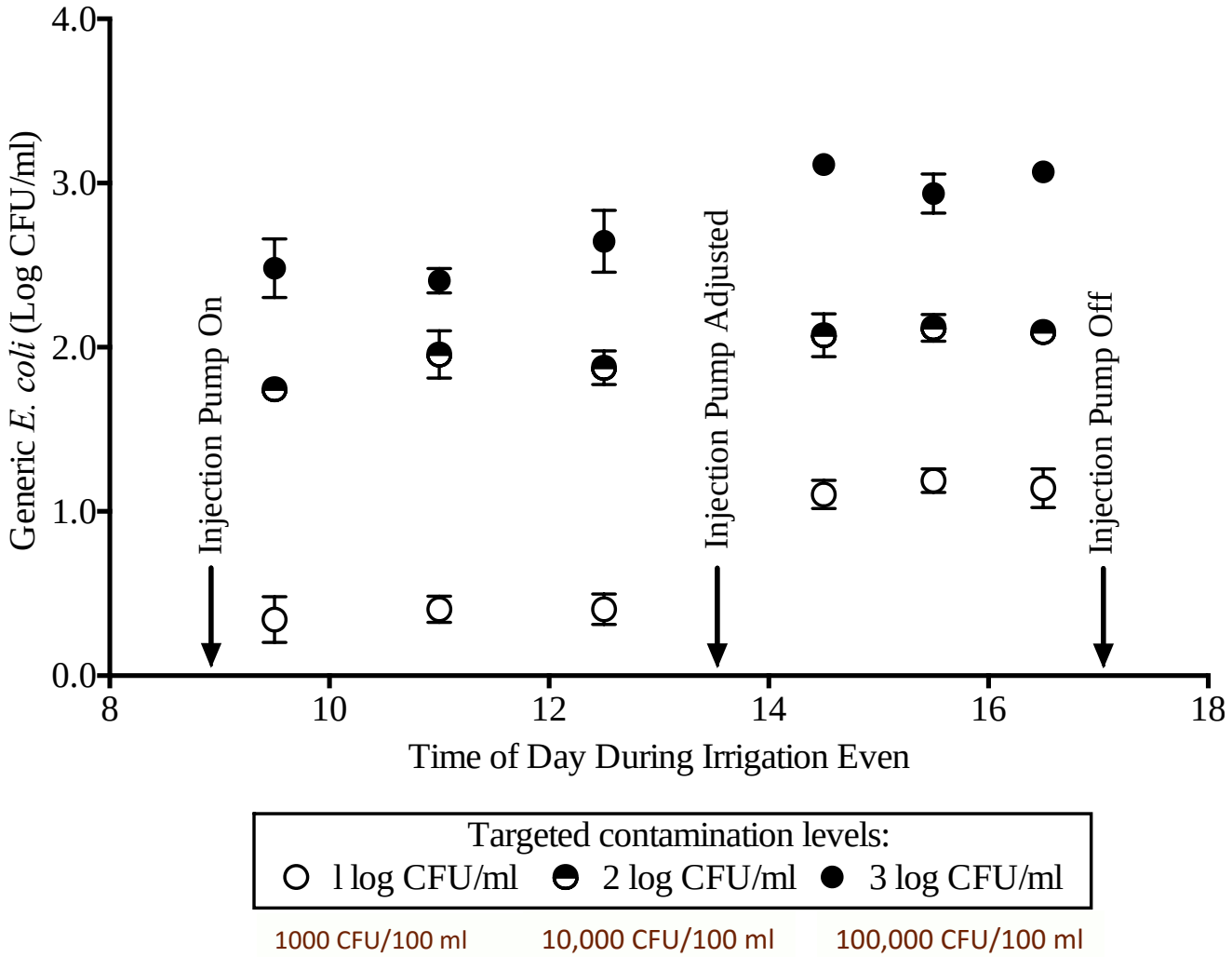
Field Layout





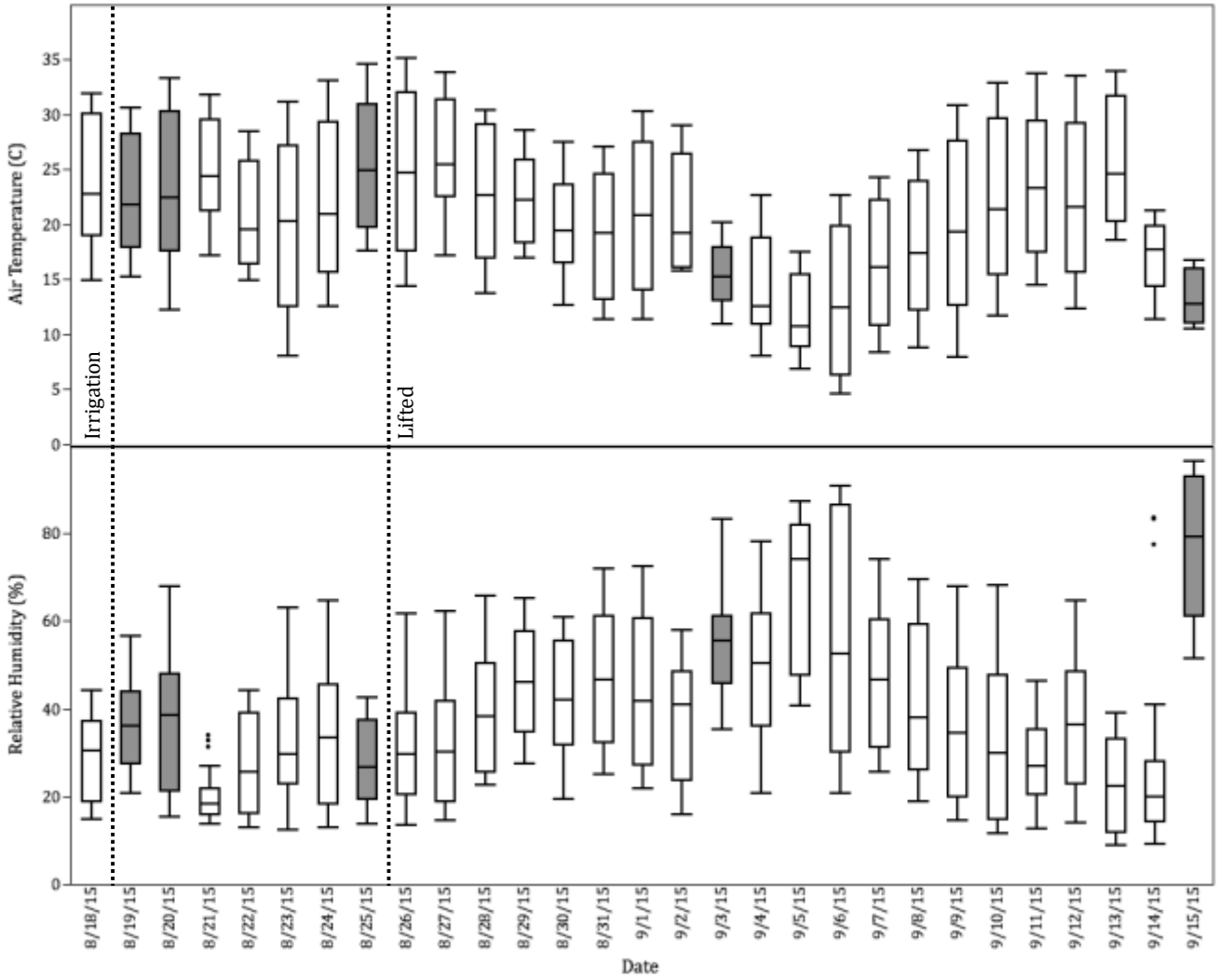
Mobile Command Centers

Contaminated Irrigation Monitoring – Day 0



IDEXX ColiSure

Why field trials are great and terrible at the same time…



Onion Contamination Rates During Finishing

Onion analysis

Targeted Irrigation Water Contamination Level	Total Generic E. coli Applied during irrigation (log CFU/tape)	Onion samples positive for generic E. coli				
		Days post-irrigation				
		1				
Uninoculated	0	0/150				
1000 CFU/100 ml	700,000	0/150				
10,000 CFU/100 ml	8,900,000	9/150				
100,000 CFU/100 ml	63,000,000	20/150				

Research Conclusions

- Do finishing practices used by the onion industry mitigate any potential risk associated with poor water quality?

Yes, conventional curing practices (extended irrigation to harvest intervals) mitigate contamination from very poor quality irrigation water (>100,000/100 ml).

Caveats: Drip irrigation, soil type, weather conditions.

For more information – see research publications:

- Emch, A.W., J.G. Waite-Cusic. 2016. Conventional curing practices reduce generic *Escherchia coli* and *Salmonella* spp. on dry bulb onions produced with contaminated irrigation water. Food Microbiology. 53(B): 41-47.
- Wright, D., E. Feibert, S. Reitz, C. Shock, and J. Waite-Cusic. 2018. Field evidence supporting conventional onion curing practices as a strategy to mitigate *Escherichia coli* contamination from irrigation water. Journal of Food Protection (in press).

Microbiological quality of agricultural water on Oregon's vegetable/berry farms

Joy Waite-Cusic and Lauren Gwin

Sources and control of *Listeria* in Pacific Northwest Produce

Jovana Kovacevic, Dave Stone, and Joy Waite-Cusic

Oregon State University

Microbiological quality of agricultural water on Oregon's vegetable/berry farms

- Characterize water sources and water use in Oregon's produce industry **We need you!**
- Perform a high level analysis of the microbiological quality of water used by Oregon's specialty crop farms using available water testing data **We need you!**
- Characterize the microbiological quality of agricultural water of multiple farms utilizing the same surface water source - potential for sharing water testing data **We need you!**
- Provide Oregon's specialty crop industries with training to assist with compliance of the agricultural water quality standards, including testing and mitigation strategies

We need you!

Sources and control of *Listeria* in Pacific Northwest Produce

- Investigate the prevalence, contamination points, and characteristics of *Listeria* spp. in produce growing, handling and processing environments

We need you!

- Perform targeted sampling in produce handling and processing environments to identify high risk areas and harborage sites for L*isteria monocytogenes*

We need you!

- Provide Oregon's specialty crop industries with training and education on new guidelines, sources of *Listeria* contamination, dissemination and controls, environmental monitoring for *Listeria* spp., and hands-on training for environmental sample collection

We need you!

  - Survey to capture current status and costs of environmental monitoring programs

We need you!

Additional Product Safety Rule Training

Compliance Training – Produce Safety Alliance

- Oregon Department of Agriculture
- Oregon State University
- Others

Add-on Curriculum – commodity- or topic-specific

- Western Regional Center to Enhance Food Safety (OSU)
- Oregon State University – USDA FSOP Grant
  - Small and very small growers
  - Bilingual
- Oregon State University – SCBGP Grants
  - Agricultural water testing and calculations
  - Environmental monitoring

On-Farm Readiness Review

- Oregon Department of Agriculture/Oregon State University

What do you need?

Acknowledgments





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Selena Callahan - OSU

Thank you for your time.
I am happy to answer questions.

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