Production Practices and Dry Bulb Onion Safety: Research Update

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Oregon State University

Dry Bulb Onion Food Safety Projects

Contamination during pre-harvest production

Jason Racine

Improving food safety during post-harvest and minimizing recalls

Sasha Nerney

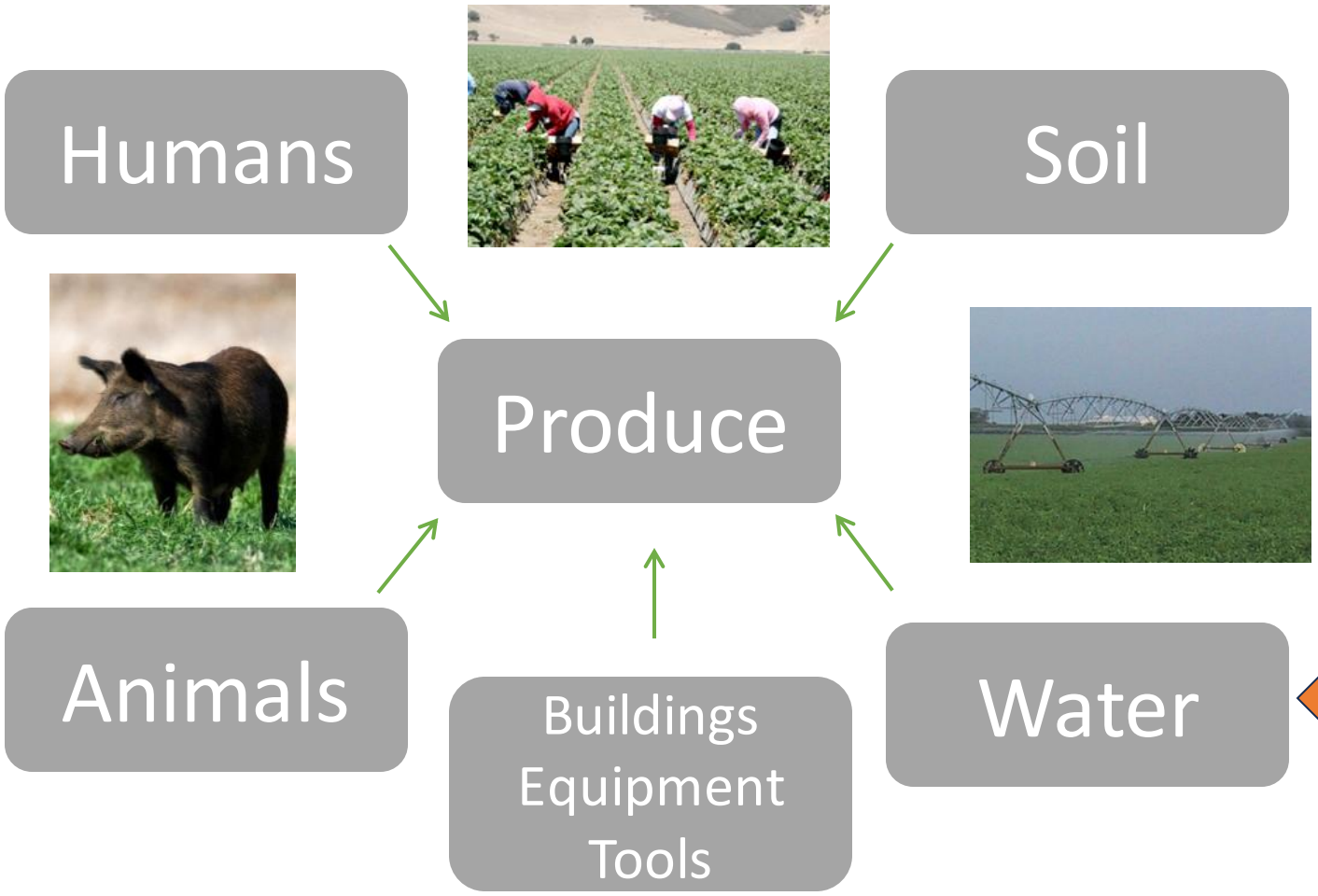
Need for Investigation

- 2 Outbreaks 2020 & 2021
  - *Salmonella* linked to onions
  - >2,000 cases

Contamination Sources

Investigate Contaminated Water applications:

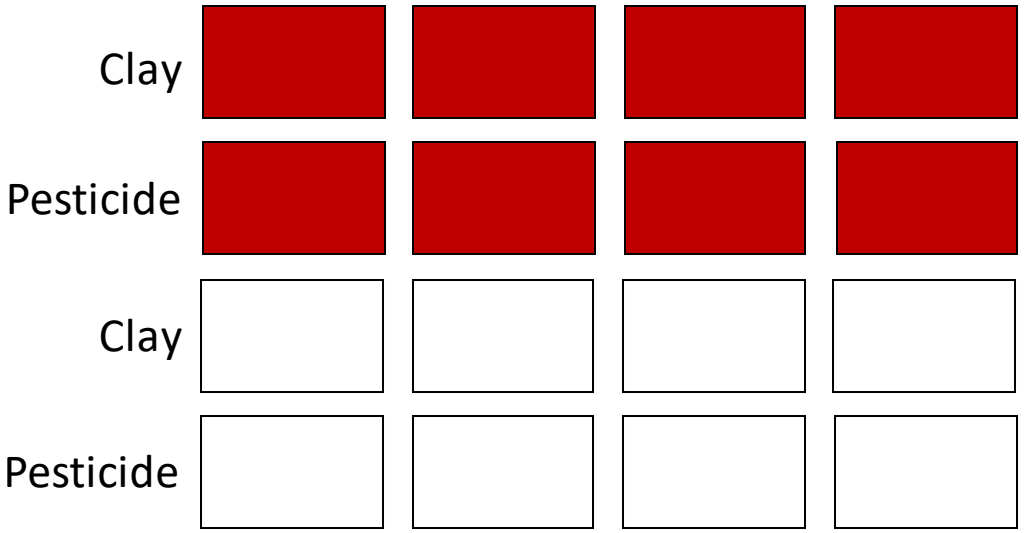
- **Oregon Pesticide (Pristine) and Clay (Kaolin)**
- **Washington Drip and Overhead irrigation**



Most likely source in onions

Does Contaminated Water Lead to Outbreaks from Crop Protection Sprays?

Oregon



Clay vs Pesticide Application

16 fields, red and white onions

Using standard growing practices

2022 Last Irrigation Event

Inoculated August 23rd

Samples collected

Day 0, 0.25, 2, 4, 7, 16, 29

Harvested September 21st

2023 Last Irrigation Event

Inoculated August 14th

Samples collected

Day 0, 1, 7, 29

Harvested September 12th

What we found in 2022

1/320 Onions!

Percentage of Onions Positive w/ *E. coli*

Treatment	Onion Color	Hour 0	Hour 6	Day 1	Day 2	Day 7	Day 16	Day 29
Clay ~200CFU/100ml	White	52.5% ~3 cells/onion	20.0%	10.0% ~1 cell/onion	0.0%	0.0%	0.0%	0.0%
Clay ~400CFU/100ml	Red	60.0% ~3 cells/onion	5.0%	7.5% ~1 cell/onion	0.0%	0.0%	0.0%	0.0%
Pesticide ~500CFU/100ml	White	72.5% ~8 cells/onion	20.0%	7.5% ~1 cell/onion	0.0%	0.0%	0.0%	0.0%
Pesticide ~200CFU/100ml	Red	87.5% ~10 cells/onion	30.0%	10.0% ~1 cell/onion	0.0%	0.0%	0.0%	1.3%

What we found in 2023

3/320 Onions

Percentage of Onions Positive w/ *E. coli*

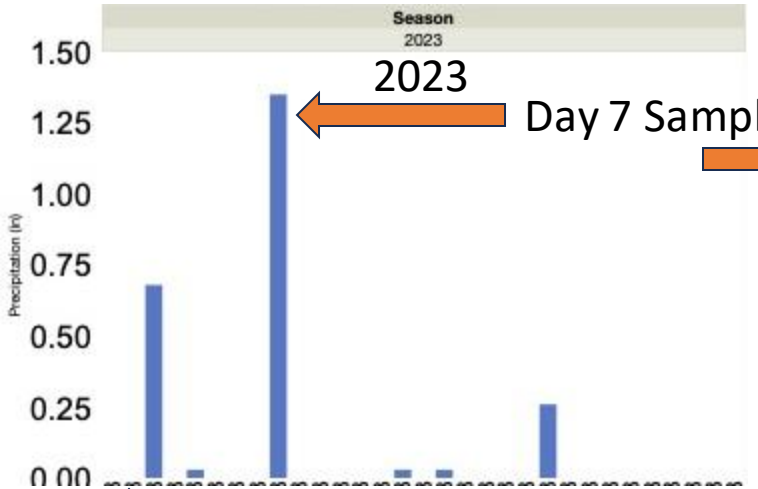
Treatment	Onion Color	Hour 0	Day 1	Day 7	Day 29
Clay ~850 CFU/100ml	White	45.0% ~12 cells/onion	7.5% ~2 cells/onion	7.5% ~2 cells/onion	2.5% ~2 cell/onion
Clay ~940 CFU/100ml	Red	80.0% ~28 cells/onion	7.5% ~1 cell/onion	0.0%	0.0%
Pesticide ~395 CFU/100ml	White	77.5% ~51 cells/onion	20.0% ~3 cells/onion	17.5% ~21 cells/onion	0.0%
Pesticide ~340 CFU/100ml	Red	92.5% ~28 cells/onion	35.0% ~3 cells/onion	17.5% ~5 cells/onion	1.3% ~2 cell/onion

What Was Different?

Ontario, OR

2022

8/23/22-9/21/22
0 inches precipitation



2023

Day 7 Sampling

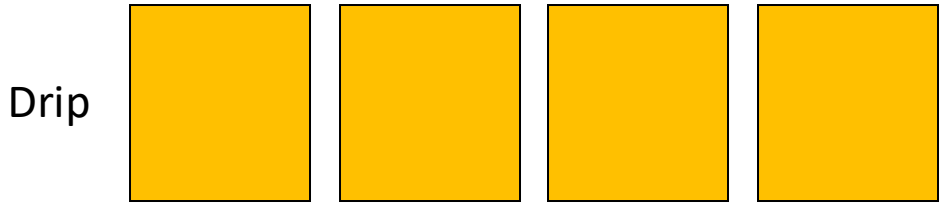
8/13/23-9/12/23

Inoculation

Harvest

Is Drip Irrigation a Risk when using Contaminated Water?

Washington



Drip Irrigation

4 fields, yellow onions

Using standard growing practices

2022 Last Irrigation Event

Inoculated August 17th

Samples collected

Day 0, 1, 2, 4, 7, 15, 28

Harvested September 14th

2023 Last Irrigation Event

Inoculated August 8th

Samples collected

Day 0, 1, 7, 29

Harvested September 6th

What we found from Drip Irrigation

2022

Percentage of Onions Positive w/ *E. coli*

Treatment	Onion Color	Hour 0	Day 1	Day 2	Day 7	Day 15	Day 28
Drip ~1600 CFU/100ml	Yellow	0.0%	12.5% ~7 cells/onion	0.0%	0.0%	0.0%	0.0%

2023

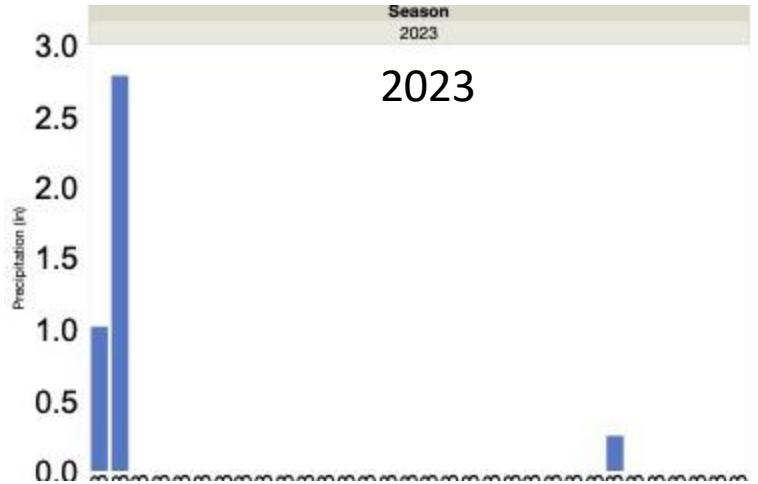
Treatment	Onion Color	Hour 0	Day 1	Day 7	Day 29
Drip ~126,000 CFU/100ml	Yellow	62.5% ~142 cells/onion	67.5% ~51 cells/onion	15% ~517 cells/onion	1.25% ~2 cell/onion

1/80 Onions

Consider Seasonal Variability

Pasco, WA

8/17/22-9/14/22
0 inches precipitation



8/6/23-9/6/23

Inoculation

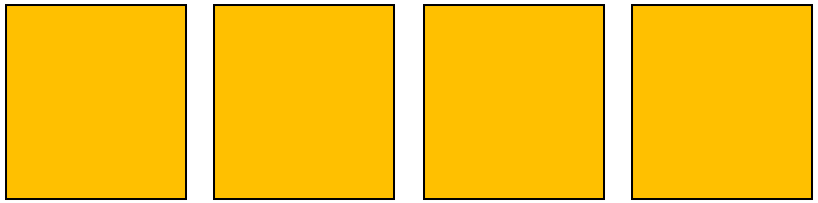
Harvest

Is Overhead Irrigation any Different?

2022 Overhead Irrigation

4 fields, yellow onions

Using standard growing practices



Last Irrigation Event

Inoculated August 17th

Samples collected

Day 0, 1, 2, 4, 7, 15, 28

Harvested September 14th

Treatment	Onion Color	Hour 0	Day 1	Day 2	Day 7	Day 15	Day 28
Overhead ~2000 CFU/100ml	Yellow	95.0% ~9 cells/onion	77.5% ~5 cells/onion	47.5%	15.0%	2.5%	0.0%

Almost 100% Contaminated!

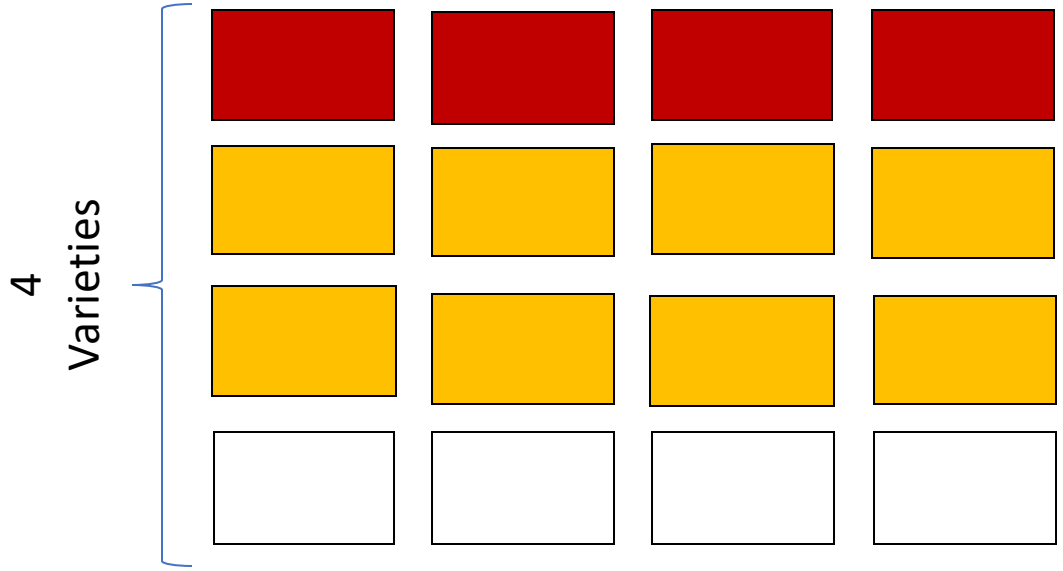
Do other Factors Contribute to the Higher Risk of Contamination?

2023

Overhead Irrigation

20 fields, yellow, red, and white onions

Using standard growing practices



Last Irrigation Event

Inoculated August 8th

Samples collected
Day 0, 1, 7, 29

Harvested September 6th

What we found This Year

Percentage of Onions Positive w/ *E. coli*

7/320 Onions

Treatment	Onion Color	Hour 0	Day 1	Day 7	Day 29
Overhead ~2000 CFU/100ml	Yellow, White, Red	98.1% ~29 cells/onion	71.9% ~20 cells/onion	6.9% ~2 cells/onion	2.2% ~3 cells/onion

Almost 100% Contaminated!

What We've Seen

- Overhead irrigation leads to higher contamination rates that take longer to die off.
- Environmental factors such as precipitation may aid in bacterial survival.

What's Next?

- Follow onions post-harvest to track lingering bacterial survival.

Location	Oct. 2022	Jan. 2023
Ontario, OR	0%	0%

Location	Nov. 2022	Feb. 2023
Pasco, WA	0%	0%

FDA response to 2020 *Salmonella* outbreak in onions

Generating data to support decision making on recall expansion


Are current practices effective?
What are barriers in industry?
What might work?

Does bacteria from onions transfer to FCS and onto new onions?

Are current practices effective? | What are barriers in industry? | What might work?

Thank you to interviewees!

Common surfaces on packing lines	Stainless steel (10) Rubber conveyor belts (10) PVC (2) "Plastic" (2)
Common surfaces during storage	Wood (8) Plastic (1) Bulk storage (1)

n = 10

Does bacteria from onions transfer to FCS and onto new onions?

Conveyor belt
Plastic
Wood

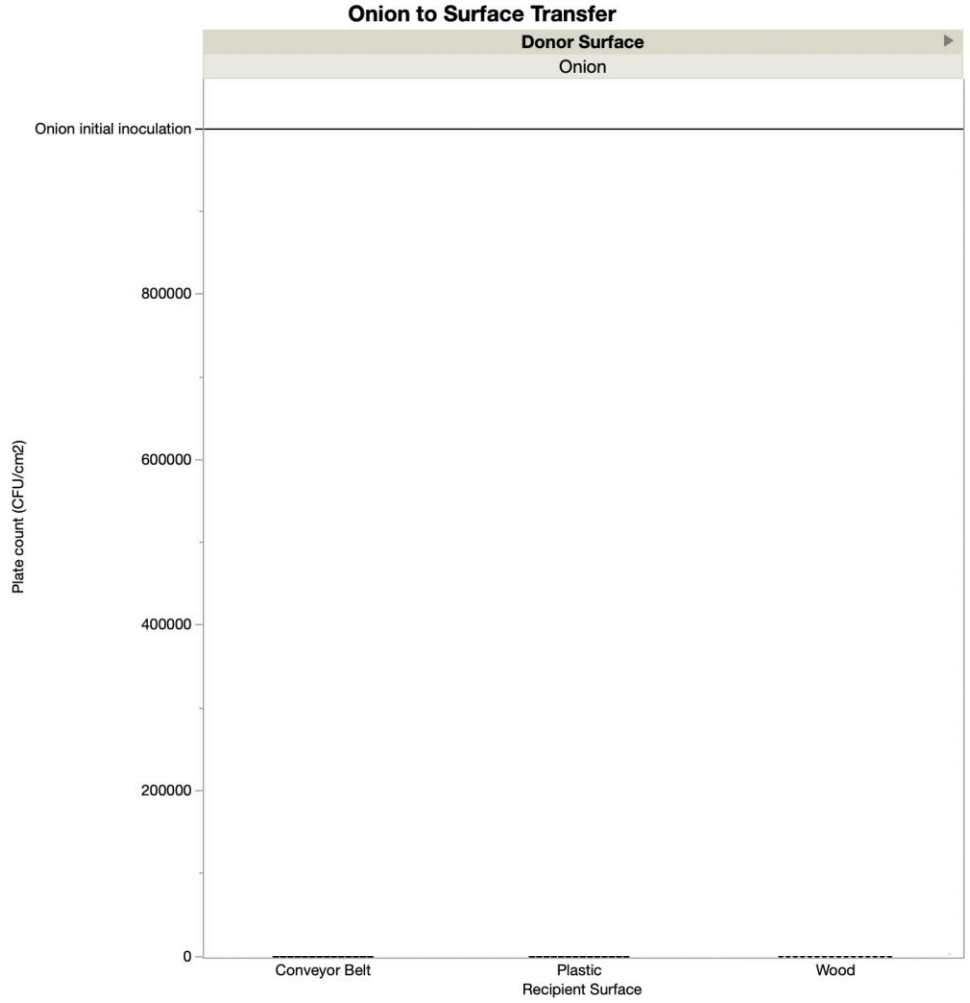
Are current practices effective? | What are barriers in industry? | What might work?

Does bacteria from onions transfer to FCS and onto new onions?

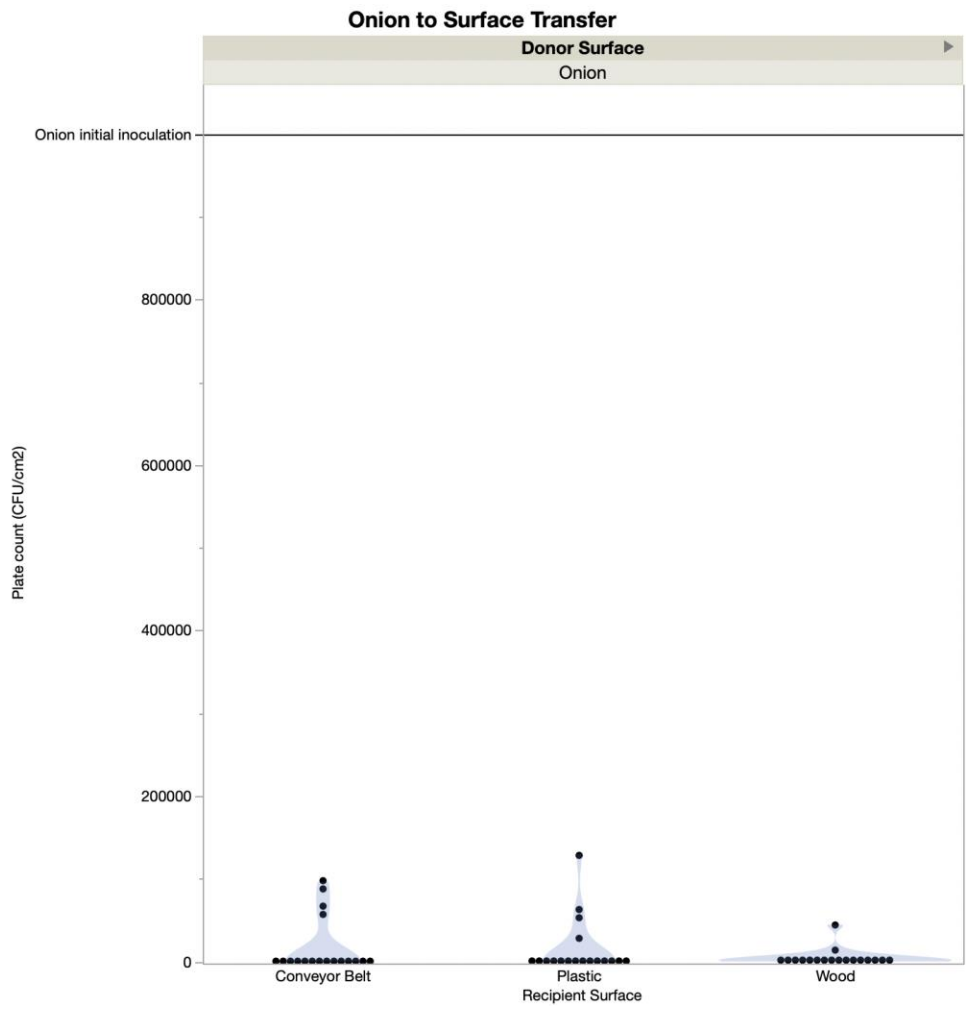
Initial *Salmonella* inoculation: ~1,000,000 CFU/cm^2

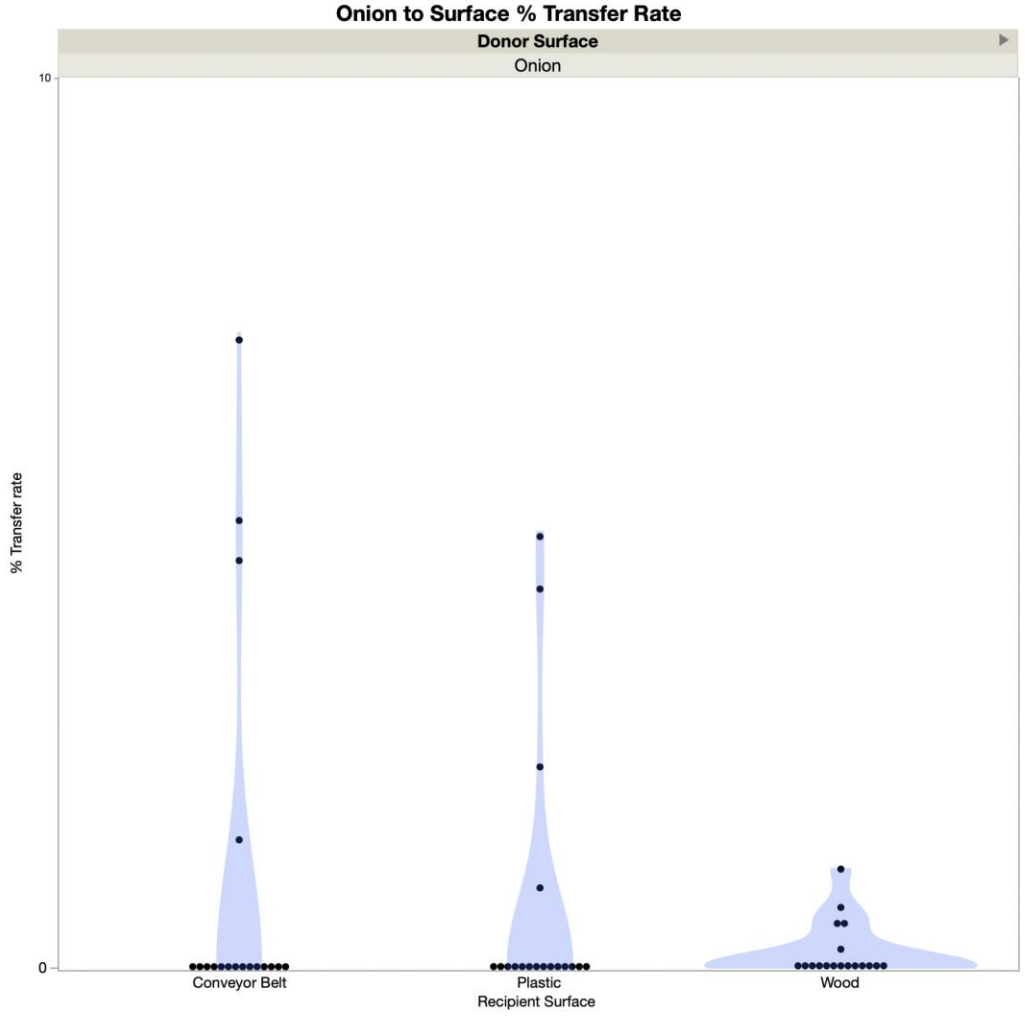
Are current practices effective? → What are barriers in industry? → What might work?

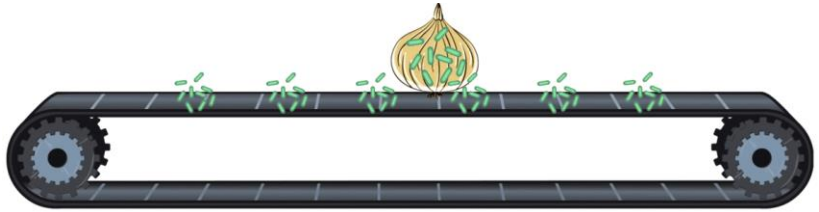
Minimal transfer from inoculated onions to surfaces



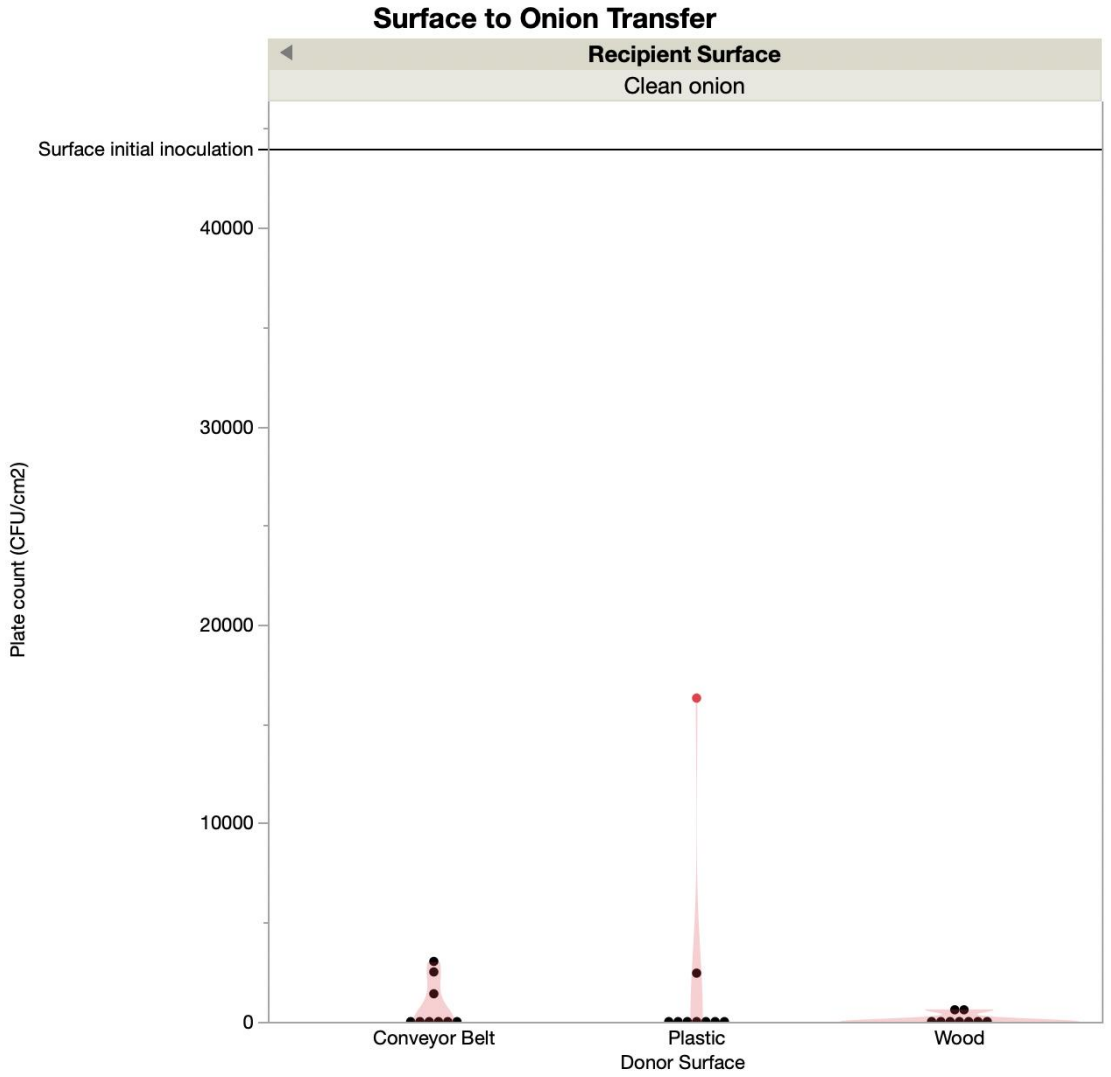
Minimal transfer from inoculated onions to surfaces

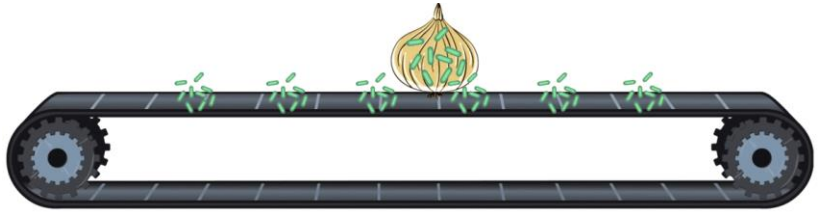




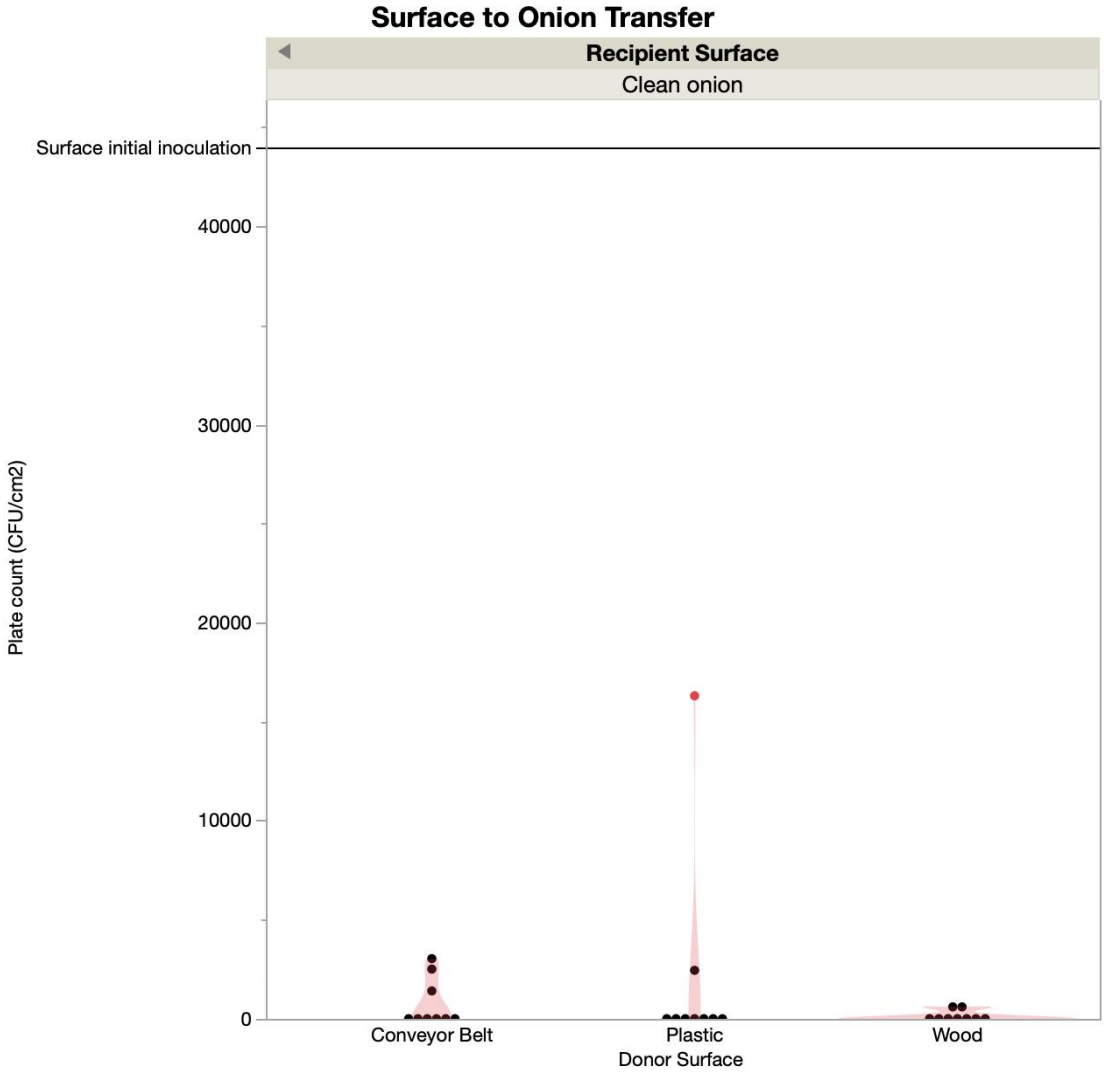


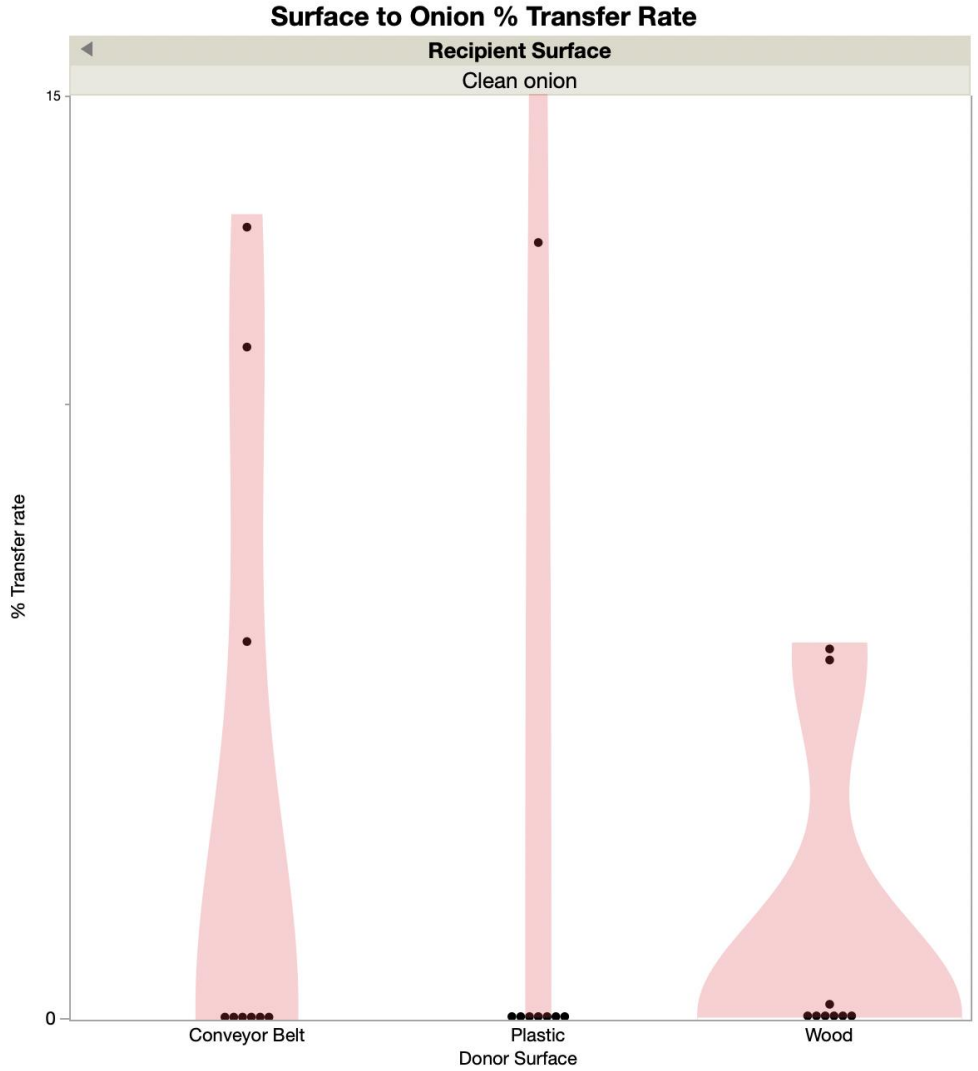
Minimal transfer from inoculated surfaces to onions





Minimal transfer from inoculated surfaces to onions





Does bacteria from onions transfer to FCS and onto new onions?

Initial *Salmonella* inoculation: ~1,000,000 CFU/cm^2

Average transferred: ~240 CFU/cm^2

Average transferred: ~10 CFU/cm^2

Are current practices effective? | What are barriers in industry? | What might work?

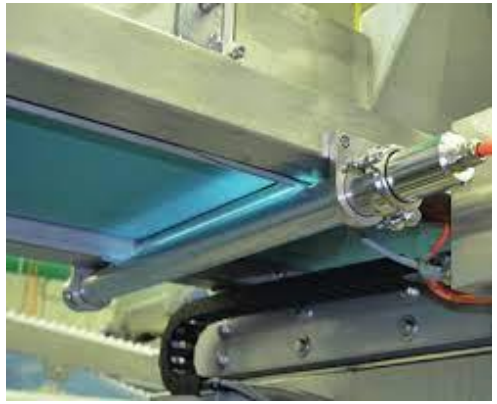
Results from Interviews

Those who **dry** clean the lines daily	10
Those who **dry** sanitize daily	4
Those who **wet** clean + sanitize between harvests	7
Those who **sanitize** storage bins	2

n = 10

Dry Sanitizer Efficacy

Establishing practical and tolerable methods for sanitation in dry packinghouses



Assessment of

- UV
- H_2O_2 cold plasma
- Ethanol based sanitizers (Purell, Dry San Duo, SaniPrime)

Are current practices effective? → What are barriers in industry? → What might work?

Final thoughts

Acknowledgements

Principle Investigators

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- Dr. Stuart Reitz
- Dr. Tim Waters
- Dr. Faith Critzer
- Dr. Linda Harris
- Dr. Jovana Kovacevic
- Dr. Dave Stone

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CENTER for PRODUCE SAFETY

Center for Produce Safety Grant

USDA

USDA Care Grant

WSDA

Washington Specialty Crop Block Grant