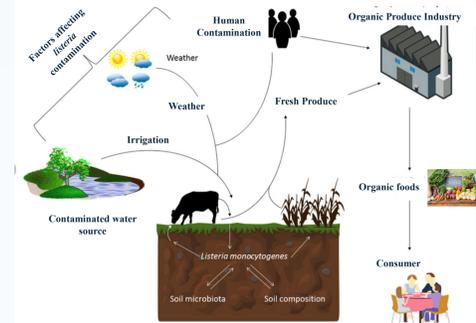
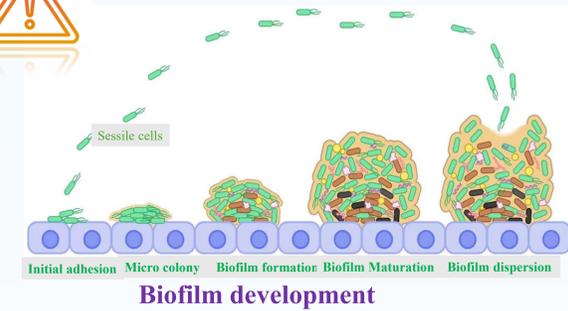


Research Problem

- Centers for Disease Control and Prevention (CDC) estimates that about 1,600 people in the U.S. get sick from *Listeria monocytogenes* bacteria each year, and about 260 people die from the infection.
- From 1998-2023: *Listeria* was responsible for 129 outbreaks, 1517 illnesses, 1191 hospitalizations, and 217 deaths (Su et al., 2024).
- Listeria* is a saprophytic organism that thrives on dead and decaying plant material, especially in environments with high organic content, common in organic farming systems.
- Although all farming systems face challenges with *Listeria*, organic producers struggle more due to the strict National Organic Program (NOP) guidelines required for certification.
- The NOP guidelines limit the use of conventional chemical sanitizers, making pathogen control more difficult for organic farmers.
- This experiment evaluates two approved technologies, UV-C light (a non-thermal disinfection method) and peracetic acid (PAA), for their potential to reduce *Listeria* on organic produce surfaces.

Zero tolerance for *Listeria* in foods



Listeria monocytogenes in the environment and food chain

UVC Tunnel Prototype



UV-C LIGHT SYSTEM

Individually controlled four modules for a flexible disinfection process. Each module uses low-pressure mercury lamps with multi-watt setups (35W, 60W, 95W) to provide optimized surface coverage

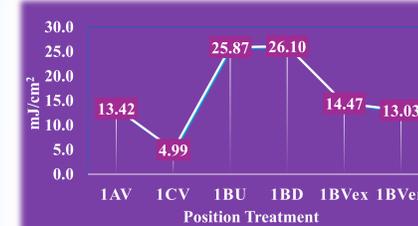
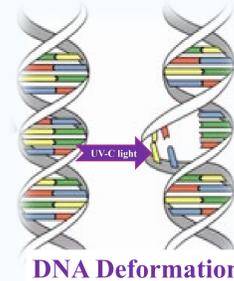
SPRAY NOZZLE SYSTEM

28 nozzles (7/module) deliver 3 gallons of sanitizer per minute for 360° exposure on all surfaces. Modules can be operated independently to ensure targeted, consistent sanitizer spray

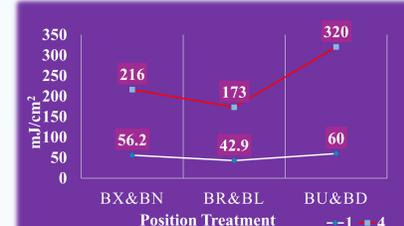
CONVEYOR BELT SYSTEM

Adjustable speed to control UV-C dose and liquid sanitizer exposure time

DUAL ACTION OF INTEGRATED SANITATION SYSTEM ON BACTERIAL CELLS



UV-C dose delivered using a single UV module

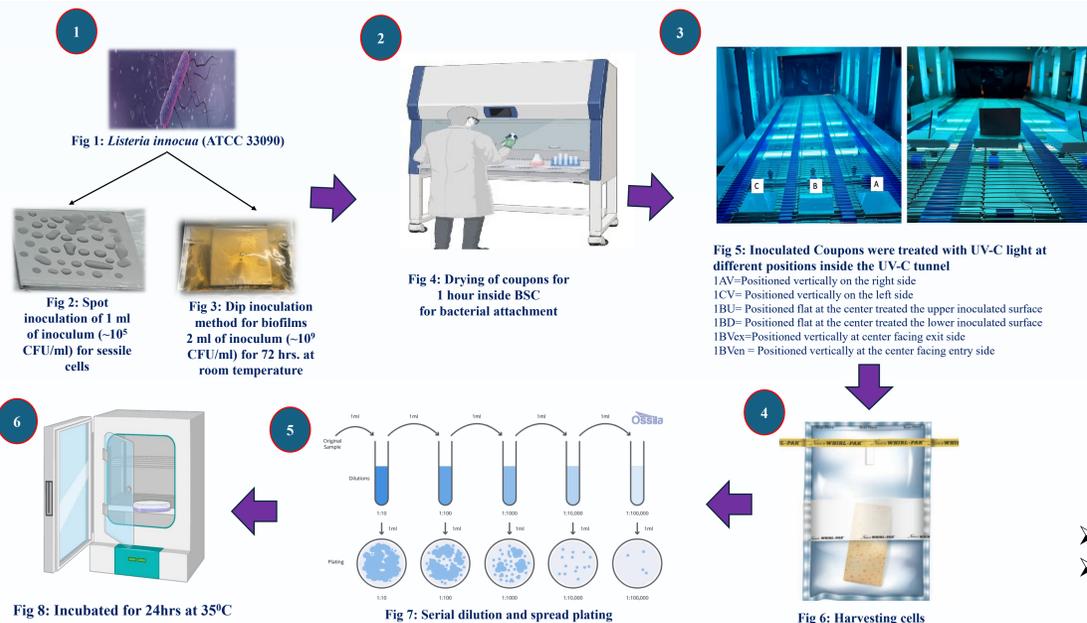


Cumulative UV-C dose delivered with 1 and 4 modules

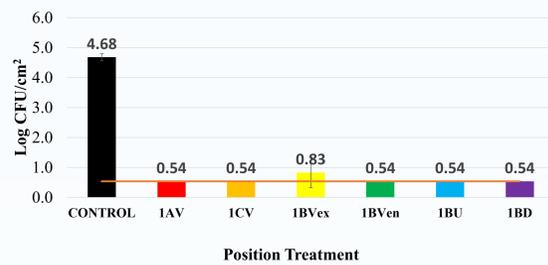
Objective

- To develop a UV tunnel combining UV-C light and a nozzle spray system to control *Listeria* sessile and biofilm cells on stainless steel surfaces.

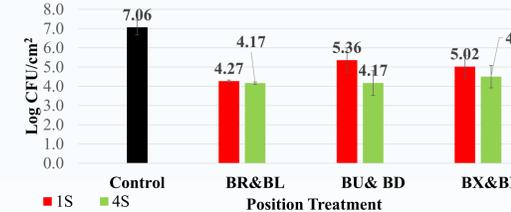
Material and Methods



Results and Discussion

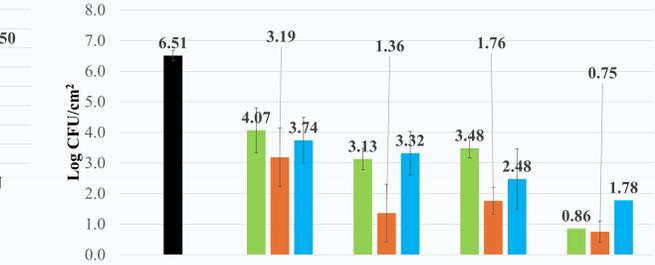


UV-C light effect on sessile cells log population at different positions inside the UV-C tunnel



Different positions inside the tunnel
 BU & BD = Positioned flat at the center.
 BX & BN = Positioned vertically at center facing exit side and entry side
 BR & BL = Positioned vertically at center facing right side and left side

UV-C light effect on biofilm cells log population at different positions inside the UV-C tunnel



Effect of combined treatments UV-C + PAA (120 ppm) on biofilm cells log population at different positions inside the UV-C tunnel

- UV-C light reduces *Listeria* sessile cells to below detectable levels (0.54 log CFU/cm²) at different positions on stainless-steel surfaces.
- No statistically significant differences were observed among the treatments (no. of modules employed) or between the position treatments and the UV-C light modules when biofilms were treated with only UV-C light.
- Biofilms were significantly reduced with combined treatments (UV-C+PAA) across both systems (1 and 4) and with significant differences between exposure times of 1 min and 3 min.
- High microbial reduction was recorded with low speed (3 mins) on flat-positioned coupons at the center of the conveyor belt.

Conclusion

- UV-C and sanitizer combinations effectively reduce *Listeria* on food-contact surfaces.
- A **scalable and adaptable system** suitable for various surface types, suitable for organic farms and small producers.

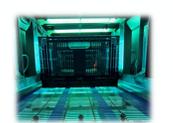
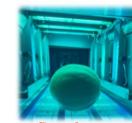
Future Studies

- Field validation** will be conducted on food contact surfaces at organic farms in Kansas, Georgia, Arizona, and Florida to assess on-farm effectiveness.
- Produce testing** will focus on cantaloupes, avocados, and pears to evaluate how well the system works on irregular, textured surfaces.

Acknowledgement

Research was funded by the USDA, NIFA, Organic Agriculture Research and Extension Initiative (OREI) Award No. 2022-51300-37885.

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- Treatments were randomized across three coupons per treatment, with experiments replicated three times.
- Data were analyzed using GLM in SAS 9.4 and ANOVA in R version 4.4.2 with Tukey's HSD ($p \leq 0.05$)