Does *Salmonella* Move Through the Irrigation Systems of Mixed Produce Farms of the Southeastern United States?

RESEARCH COMPLETED

SUMMARY

Our previous work has shown that *Salmonella* is present in surface waters used for irrigating produce in the southeastern U.S. The goal of this study was to understand whether *Salmonella* moves through irrigation systems and contaminates crops. The project was conducted on produce farms in southern Georgia. We collected samples from irrigation systems and their sources and analyzed them for *Salmonella* and generic *E. coli*. We also collected and analyzed produce samples from the fields irrigated by these systems. We found *Salmonella* in the irrigation water at about the same rates (30%) as found in the water sources. We also found *Salmonella* on two produce samples but it is not clear if the samples were contaminated by the irrigation water. We repeated the experiment using in-line chlorination systems to determine if irrigation water can be effectively disinfected. We found a greater than 50% reduction in the number of positive samples collected downstream of chlorination injection points.

OBJECTIVES

1. Sample water sources and irrigation systems on southeastern farms to determine if *Salmonella* moves through the irrigation systems.
2. Determine if *Salmonella* in irrigation water contaminates produce and if the *Salmonella* persists on the crop until harvest.
3. Assess if pathogen loads in irrigation water can be effectively mitigated by disinfecting the irrigation water with chlorination.
4. Assess the validity of using generic *E. coli* as an indicator for *Salmonella* under southeastern Coastal Plain conditions.

METHODS

During Year 1, we measured *Salmonella* and generic *E. coli* concentrations in 94 water samples from five overhead and three drip irrigation systems and their water sources. The water sources were three irrigation ponds and a groundwater well. We also collected and analyzed 65 produce samples from bell pepper, broccoli, cantaloupe, collard greens, cucumbers, mustard greens, squash, watermelon, and zucchini from the fields irrigated by these systems. Confirmed *Salmonella* isolates were analyzed by PFGE. A subset of the isolates were serotyped. During Year 2, we repeated the experiment using calcium hypochlorite tablet chlorination systems to assess if pathogen loads in irrigation water can be effectively mitigated by disinfecting the irrigation water with chlorination. Between this and other recently completed projects, we collected in excess of 500 water samples, all of which we analyzed for *Salmonella* and generic *E. coli* concentrations. We analyzed the data to assess validity of measuring generic *E. coli* as an indicator for *Salmonella*.

RESULTS TO DATE

Thirty-three percent of samples collected from ponds and 30% of samples from irrigation systems using the ponds were positive for *Salmonella*. Concentrations were low and consistently below 1 MPN/100 mL. Nine different serovars were identified in water samples, with *S.* Muenchen and *S.* Saintpaul making up 65% of the isolates. *Salmonella* was detected on two produce samples – cantaloupe (pivot irrigation) and cucumber (drip irrigation) – but the serovars were not found in any of the irrigation water samples so other environmental factors may be responsible. Chlorination with 2 ppm residual free chlorine resulted in greater than 50% reductions in the percentage of samples positive for *Salmonella* and an even greater reduction in the percentage of samples positive for generic *E. coli*. No produce samples were found positive for *Salmonella* when irrigation water was chlorinated. Our data show that FSMA guidelines based on generic *E. coli* are not a good indicator for the presence of *Salmonella* in the ponds and irrigation systems of the southeastern Coastal Plain.

BENEFITS TO THE INDUSTRY

The results from this study provide vegetable producers that rely on surface sources for irrigation water with information to effectively address recently released FSMA rules on *safe agricultural water*. A 4-page extension booklet titled "Pre-harvest irrigation water: Methods for disinfection" provides fruit and vegetable growers with valuable and non-biased information about irrigation water disinfection systems.

Results from the 2014-2015 study to survey pathogens in irrigation system water.

Sample Source	*Salmonella*				Generic *E. coli*			
	Total	Negative	Positive	% Positive	Total	Negative	Positive	% Positive
Year 1 – 2014 (without Chlorination)								
Spigot (Well)	5	5	0	0.0	5	5	0	0.0
Drip (Well)	11	11	0	0.0	11	11	0	0.0
Pond	24	16	8	33.3	24	2	22	91.7
Spigot (Pond)	15	11	4	26.7	15	3	12	80.0
Pivot (Pond)	6	1	5	83.3	6	0	6	100.0
Solid Set (Pond)	3	3	0	0.0	3	2	1	33.3
Drip (Pond)	30	23	7	23.3	30	3	27	90.0
Total	94	70	24	25.5	94		94	100.0
Year 2 – 2015 (with Chlorination)								
Pond	35	24	11	31.4	35	8	27	77.1
Spigot (Pond)[1]	35	29	6	17.1	35	19	16	45.7
Pivot (Pond)	8	7	1	12.5	8	6	2	25.0
Solid Set (Pond)	2	2	0	0.0	2	1	1	50.0
Drip (Pond)	50	47	3	6.0	50	38	12	24.0
Total	130	109	--	16.2	130	109	21	--

[1] Rows shaded in BLUE are samples collected downstream of the chlorination system.

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