

Methods for determining groundwater under the influence of surface water, and BMPs for mitigating distribution system contamination

Summary

This proposal addresses a critical knowledge gap in microbial issues in fresh produce irrigation sources and distribution systems. Our project collaborates with growers in Arizona, California, Florida, and Georgia to identify groundwater wells that may be under the influence of surface water. The research and Extension team will use innovative microbiological sampling techniques coupled with historical records review to assess groundwater source vulnerability. In the second phase, the research and Extension team will evaluate interventions like pipe flushing, shock chlorination, and water treatment to establish effective mitigation measures for acute and chronic irrigation pipe distribution system contamination. Success will be measured by industry adoption of our recommended sampling strategies and Best Management Practices for remediation of distribution system contamination.

Objectives

1. Objective 1: Identify ten groundwater wells that are suspected as being under the influence of surface water in four produce growing regions of the US including AZ, CA, FL, and GA. Wells will be evaluated using various alternative water sampling methodologies (100 mL vs 1L vs 100 L) and parameters at least 2 times each over the course of year 1.
2. Objective 2. Using water quality data collected in year one, in addition to intensive grower records review, the research team will identify trends, correlations and recommended monitoring strategies for industry to use to effectively evaluate surface water and ground water connectivity.
3. Objective 3. Using model irrigation system pipe-loop distribution systems, evaluate industry BMPs for mitigation of acute/chronic distribution system contamination.

Methods

In collaboration with growers in Arizona, California, Florida, and Georgia, the first phase of this project involves identifying groundwater wells under the influence of surface water, using innovative sampling techniques (e.g., 100 L sample volumes) and assessing both traditional and non-traditional parameters, including generic *Escherichia coli*, Total Coliform bacteria, bacteriophage, protozoa, and Microscopic Particulate Analysis. This comprehensive monitoring, coupled with records review, will guide the industry on suitable sampling methods to detect surface water influence on groundwater. The second phase of this project entails constructing irrigation distribution system pipe-loops in three locations to assess impacts of atmospheric and water quality conditions on water quality degradation (Figs. 2,3). Upon biofilm establishment, interventions—pipe flushing, pipe shocking using sodium hypochlorite, and routine water treatment—will be evaluated for efficacy.

Results to Date

The project team has completed well assessments and had initiated work to evaluate irrigation water distribution system impacts resulting from the use of organic fertilizers and “mock” microbial contamination. Results indicate rapid microbial growth within short periods of time (< 7 days) and orders of magnitude increases in microbial concentration in both the circulated water as well as biofilm swabs, ranging from ~1.8 to 2 log/100ml to ~7.6 to 7.7 log /100ml in irrigation water, and from ~1.2 log/swab to >8 log/swab on pipe. These results were similar in varying pipe materials including both aluminum and PVC pipe. Of note, microbial concentrations remained elevated after subsequent “clean” irrigation water introductions regardless of any new microbial introduction indicating that once irrigation pipe(s) becomes contaminated, in the presence of organic fertilizer, bacteria may persist at extended periods of time with no interventions in place.

Benefits to the Industry

This project aims to provide guidance to industry on the general process and field sampling methodology for determining hydraulic connectivity and acute/chronic distribution system contamination through water quality monitoring and boots on the ground assessment in addition to suggested Best Management Practices to manage contamination.



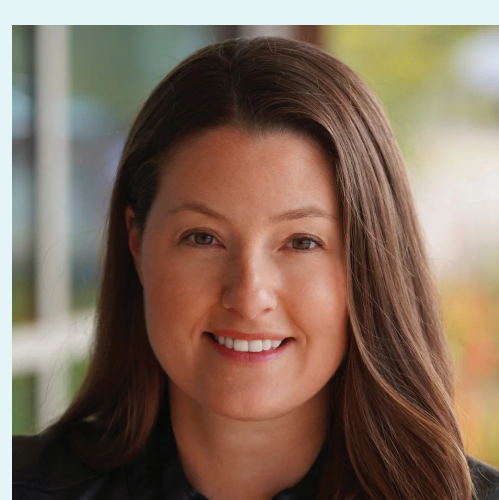
Figure 1:
Aluminum Irrigation Pipe Loop



Figure 2:
Cross sections of aluminum pipe used for mock irrigation of fresh produce with surface water over 28 days showing substantial biofilm development.



Figure 3:
Cross sections of PVC pipe used for mock irrigation of fresh produce with surface water over 28 days showing substantial biofilm development.



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