Remaining Questions from Agricultural Water Treatment: It's Not Rocket Science… Or Is It?

December 3, 2021

Below are the questions from the Q&A session that were not answered due to time. Identifying information has been removed and grammatical or spelling errors corrected (expressed in brackets), but the content of each question has not been changed from how it was submitted.

Administrative

1. Do you plan to post on a project website (or other) some of these hard-earned experiences [and] practices that could serve as a grower decision-support system?

   The content and questions and answers discussed during the Q&A session and those included in this document will be summarized and posted on the project website as a "Key Takeaways" publication. This Q&A document will also be posted in its entirety.

   -CONTACT Team

2. Is this being recorded?

   This webinar was not recorded. In its place, we will post a summary "Key Takeaways" document for those who were not able to attend the webinar or would like revisit the content in the future.

   -CONTACT Team

Assessment of Risk

1. Where is the science that also touts [die-off] rates and how that compares? Identify high-risk crops and situations (canals, etc.) and focus on those. Please stop thinking that every water source and crop needs treatment.

   One of the great aspects of the goal of water source review is to help growers assess if their water source needs to be treated. This can be determined by water source sample result history and the designated use. Every source does not need to be treated, but a strong review program and risk assessment to determine that is important. We understand that "blanket" approaches do not work. This is why we encourage operations to focus on their unique hazards and potential risks and determine with science-based approaches to develop preventative programs.

   -LT

2. [I]s there a risk to the soil from a [build-up] of salts when using certain types of chlorine?

   This is a great question! The goal for end-line ppm of Free Cl in the southeast was a range of 2-4 ppm. This is the same range that water treatment plants are aiming for with drinking water that can later end up in our homes. That being said, we always need to look at long-term potential impacts that address different types of soil, application, and how they interact with the different water treatment chemistries. This is being looked at, but the current view is that if it is safe for the tap, it should be safe for the field as well. Working with suppliers and monitoring

with soil samples for individual operations may help with determining impacts after treatment use over time, if there are concerns.

-LT

3. If treatment of furrow irrigation water is not effective, what can be done to remove food safety risks from current furrow irrigation practices? Please consider all crop management and harvest practices[.]

   Because furrow water typically does not contact the harvestable portion of the crop, it would be considered a reduced risk than overhead or sprinkler application. Routine visual inspection is important to ensure source and furrow water does not pose a risk of contamination (remove sediment, debris, weeds, trash; keep equipment clean and in good working order) and agricultural practices that avoid water from breaching the top of the bed and potentially contaminating produce (bed configuration, equipment movement, monitor headland and tail ditch location for damaged beds).

   -LC

4. What are the main concerns associated with drip and buried drip irrigation?

   Because drip irrigation does not allow for water to come into contact with the harvestable portion of the crop, this practice would be considered relatively low risk. A few things to consider would be the frequency that the equipment is cleaning and how cleanable it is (frequency of use, duration and method of storage, replacement intervals, how does the material interact with the chosen treatment chemistry). There is potential for biofilm formation to occur in the inside of the distribution system, so it is important to assess the drip tape over time and replace it with necessary.

   -LT

<u>Real-World Applications</u>

1. The effectiveness of any water treatment is dependent on the quality of the water entering the system. This can vary from [day-to-day,] particularly if using surface water sources. What are the pre-treatments needed and recommended? How can the water user assess the incoming water quality without facing [a] large cost in testing? What are the factors that are likely to occur to incoming water such that the treatment would no longer be effective?

   Initially one of the goals for the water profile building was to assess the water source at different times, close to use, to help operations understand how the water quality fluctuated over time. If water sources are at risk of frequent microbial quality fluctuations, it may be best to determine high and low of those fluctuations. Monitoring at the end of the system would be the best indicator that fluctuations are being managed. For example, testing for free chlorine at the end of the line, would let operations know if the treatment chemistry was being used up entirely and the injection amount needed to be adjusted, or if the desired range of free chlorine ppm is being achieved. Factors that can impact treatment effectiveness, especially for chlorine, would be changes in pH and/or increases in suspended soils and sediment in the water table. This could also be influenced by the setup of your intake system (if it has filters, pulls water from surface or bottom of source). Based on microbial quality fluctuation potential, the risk assessment for a source like this may want to increase the frequency of end line monitoring to make sure that free chlorine amounts are in effective ranges.

   -LT

2. Can you help us to understand how we could apply the FDA [die-off] rates for [*E. coli*] in water in a field situation?

   Recent updated 'proposed' language to the Agriculture Water requirements in the Produce Safety rule, continue to mention die-off as a potential mechanism for growers to mitigate microbial hazards in the field. It is important to note however, that each farm/ranch environmental conditions are unique and that individual assessments of die-off may be needed in they are going to be used effectively.

   -CR

3. What sorts of tools or technologies are you seeing farmers use to manage their water risk that land within the FS [certification] and Organic [certification]?

   The Produce Safety Alliance maintains a open access database of water treatment options available to growers along with the appropriate label specifications and guidelines for use. Consider using a product that can be used for organic and conventional production, a computer database to collect all data, and use LGMA water section as a guidance.

   -LC

   Peroxyacetic acid is primarily seen with organic operations.

   -LT

4. I farm in the arid west just downstream of [three] million people[,] so our river water quality (DO, temp, NTU, pH…) change hourly due to diurnal flows. Have any of you had to deal with these types of conditions and[,] if so[,] how do you deal with that variability of source water?

   Have not dealt with this before, but this is a prime example of how water sources can have so many influences. Monitoring at the end of the system would be the best indicator that fluctuations are being managed. For example, testing for free chlorine at the end of the line, would let operations know if the treatment chemistry was being used up entirely and the injection amount needed to be adjusted, or if the desired range of free chlorine ppm is being achieved. Factors that can impact treatment effectiveness, especially for chlorine, would be changes in pH and/or increases in suspended soils and sediment in the water table. This could also be influenced by the setup of your intake system (if it has filters, pulls water from surface or bottom of source). Based on microbial quality fluctuation potential, the risk assessment for a source like this may want to increase the frequency of end line monitoring to make sure that free chlorine amounts are in effective ranges.

   It may be suggested that for particular ranches you only irrigate at certain times of day based on your knowledge of the source water and/or design a water treatment program that would be able to handle your "worst case" scenario.

   -LT

5. Who is responsible for the oversight and management of an irrigation event when a crop is furrow irrigated, and how are concerns and high-risk conditions communicated to responsible parties?

   Farms usually have a foreman/supervisor in charge of managing irrigation events and ordering water from irrigation districts, if required. A trained employee is always present during an irrigation event to handle any issues or concerns that may arise. Our industries ensure that employees are trained at the start of the season to ensure they know what to do when a risk is identified. Conduct a risk

assessment prior to irrigation events to identify adjacent land risks that may be present.

-LC

Regulation/Industry Compliance

1. What is agricultural water according to the Produce Safety Rule? The definition mentions that it is considered ag water only if it touches the fruit. So, if the water only touches the root, is it not [considered] ag water?

   If the root is harvested, water touching the root would be considered agricultural water. If the root is not harvested, then water touching the root would not be considered agricultural water.

   -CONTACT Team

2. What is the leafy greens industry using to comply with the recent water treatment requirements?

   The recent updates to the CA and AZ LGMA's have provided previsions to allow growers to meet water quality metrics with the use of a variety of treatment options. Currently, growers within this region have used PAA, Chlorine Dioxide, Sodium and Calcium Hypochlorite, and UV to meet water quality requirements of essentially non-detect for generic *E. coli* post treatment.

   -CR

Scientific Validation

1. Would you anticipate the same reduction of [chlorine] with another fertilizer than CAN 17?

   Any organic matter or similar nutrient/nitrogen could potentially result in similar reaction as CAN 17. The UA research team also evaluated UAN32 with same results.

   -CR

2. Has anyone ever done a study on how effective the CAN 17 is, as a fertilizer, when applied a water [treatment] chemistry?

   See above.

   -CR

3. Recently I have been reading about electrocoagulation water treatment. Is there any potential for us in [ag water] for bacterial pathogens although it sounds like it is directed for removal of suspended solids?

   While that technology has not been deployed in an agricultural setting, to our knowledge, one important component would be the energy requirements needed.

   -CR

4. Has anyone considered using PAM (polyacrylamides) to control turbidity in irrigation water, a treatment Dr. Michael Cahn from the UCCE has demonstrated to be highly effective in trials conducted on the [central coast] of CA?

   I am not very knowledgeable on this treatment use, but some of the concerns around PAM is that it could denature into acrylamide, which is a known toxicant that can cause cancer. Acrylamide can readily leach into soil as well (https://www.who.int/water_sanitation_health/dwq/chemicals/acrylamide.pdf). Humans also showed neurotoxicity symptoms.

   -LT

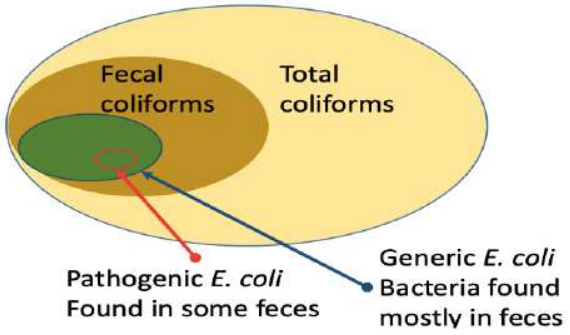
Additionally, there would be a need to determine a way to remove the coagulant from the water stream prior to an irrigation event. Typically the flow rate in agriculture system does not allow for settling due to the increased flow rate needed.

-CR

Testing

1. Why is [*E. coli*] not a good indicator of pathogens? Are they not present in the intestinal tracts of mammals?

   A majority of bacteria are not harmful to humans, as mentioned all mammals, including us, carry forms of it. *E. coli* are within a much larger group of *Enterobacteriaceae.* When focusing on generic *E. coli* in sampling, it does not encompass all pathogens, like *Salmonella*. It is more of an indicator that conditions in the source could be favorable for *Salmonella*. It is important to note that generic *E.coli* does not accurately mimic how other pathogens including viruses and protozoa survive and are transported in the environment. In the image below we can see that many pathogens of concern fall outside of *E. coli* and this does not include parasites of risk assessments, such as *Cyclospora* (https://producesafetyalliance.cornell.edu/curriculum/grower-training-manual-links/module-5/).



-LT

Water Quality

1. Thoughts about impact of factors like turbidity? Contamination events are often correlated with increased turbidity. So more [*E. coli*] and pathogens, possibly less effective [treatment] and a spike in counts even after treatment, which could be a risky situation.

   A CPS project, Dr. Rock as the PI, has shown that turbidity can play a large influence on water quality. As the disturbed soil rises into the water table, conditions can become favorable that allow the proliferation of pathogens in the open water. What was found was that turbidity, after rain events, spiked *E. coli* presence 3-4 days after the rain event. These pathogens, like humans, need certain conditions to be successful in reproducing (food, proper acidity range, time, temperature, oxygen, moisture). Additionally, increased turbidity and other organic matter can consume or bind up the treatment chemistry being used and make it un-available to disinfect or sanitize the pathogens and indicators in the

water. Working with your treatment supplier and monitoring what causes turbidity increases at the operation could help in deciding how treatment can be adjusted to mitigate spikes.

-LT