Extension
SP 740-B

Good Agricultural Practices Series

Interpreting Water Quality Test Results for Fruit and Vegetable Production

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Testing and keeping test records for water used for fruit and vegetable production (including water applied for frost protection, irrigation, fertigation, protective sprays, etc.) are an integral part of establishing good agriculture practices (GAPs) on the farm. Water testing helps to establish a baseline of water quality for your farm, and knowing how to interpret your test results is essential for identifying what food safety or production risks, if any, your water may present. A typical food safety agricultural water test should screen for quantified generic *E. coli* bacteria. Other parameters that can be useful for both general production and food safety include pH, conductivity and turbidity. This fact sheet discusses the reasons for each type of test and how to interpret water test results. Some third-party audit companies or fresh produce buyers may require other water testing parameters, so be sure to check with the auditor first if you are having a third-party food safety audit or review the contracts supplied by your buyers.

Quantified generic *Escherichia coli*

Testing for quantified generic *E. coli* is used as an indicator of fecal contamination in water. There are other tests that can be used (for example, total coliforms or fecal coliforms) as indicators of fecal contamination, but for surface waters used in the production of fresh produce, generic *E. coli* is the recommended indicator to use. These indicator organisms are present in higher numbers than potential pathogens that cause people to become ill like *E. coli* O157:H7. Figure 1 illustrates the relative levels of each indicator organism compared to pathogens. Based on this relationship, if levels of generic *E. coli* are high in your water then the chance of having a pathogen like *E. coli* O157:H7 increases and could pose a contamination risk when used to irrigate produce.

Currently there are no national irrigation water quality standards, but some fresh produce industry groups, such as the Leafy Greens Marketing Agreement, have recommended using the Environmental Protection Agency's Recreational Water Standards as guidelines.

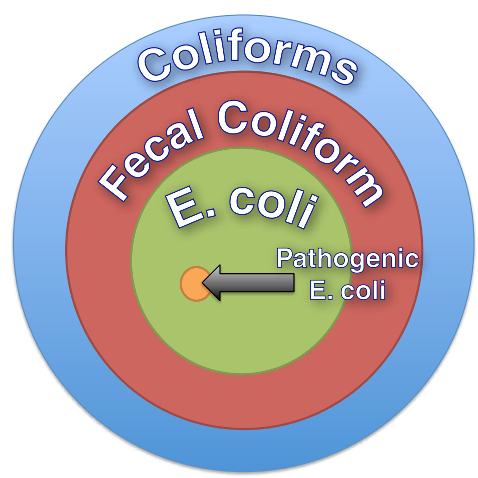

Figure 1. Relative levels of indicator organisms compared to pathogens.

Following are the general guidelines from the LGMA (http://www.caleafygreens.ca.gov/food-safety-practices); be aware they require a stringent sampling schedule:

1. When the edible portions of a crop are **NOT** contacted by water, the acceptable limits are less than or equal to 126 most probable number (MPN) or colony forming units (CFU)/100 ml, with a maximum allowable limit of less than or equal to 576 MPN or CFU/100 ml for any single sample.
2. When the edible portions of a crop **ARE** contacted by water (for example, spinach or other leafy vegetables), the acceptable limits are less than or equal to 126 MPN or CFU/100 ml, with a maximum allowable limit of less than or equal to 235 MPN or CFU/100 ml for any single sample.

The purpose of providing these numbers is to give you an idea of standards currently being used. Testing for generic *E. coli* is only an indicator of fecal contamination, not a test for known human pathogens associated with fresh produce. Right now, it is the best option and the test recommended for surface water used for the production of fresh produce.

If you are using a well to irrigate that you are also drinking from, you should be testing that well at least twice per season for presence/absence of total coliforms. The test results should be negative for total coliforms. Most county health departments offer a potable water test that will include total coliforms so you can be sure the water is safe to drink.

pH

Testing pH gives a measurement of the hydrogen ion concentration in water and indicates the relative acidity or alkalinity of your water. Test results will range from 0.0 to 14.0, where pH 7.0 is neutral, less than 7.0 is considered acidic, and greater than 7.0 is considered alkaline, or basic. The purpose of testing water pH for food safety is to provide a broad monitoring of the source. If your water pH is higher than 9.0 or lower than 5.0, it may indicate something unusual is going on in your water source. You should examine the source to see if you can determine what is causing the disruption. Also, a sudden change in pH is a food safety concern that warrants further investigation, as it could be an indication of a contamination event.

Knowing the pH of water is valuable for production purposes. Water pH influences other characteristics and reactions in the soil and water, which in turn influence the way plants take up nutrients and grow. A water pH between 6.0 and 7.0 is desirable for irrigation of most fruit and vegetable crops; however, many crops can tolerate a pH as high as 8.5. Levels outside the range of 6.0 to 8.5 may need treatment to adjust within the preferred range before use. Other effects of low or high pH include:

- If the pH is greater than 8.0, calcium in water can precipitate and clog spray nozzles, irrigation emitters and water filters.
- If the pH is lower than 6.0, corrosion of metal pipes and fittings can occur.
- If the pH is lower than 4.0, soil acidity can increase and limit nutrient availability.
- If the pH is greater than 7.0 or lower than 5.5, spray mixes can be affected, reducing the functional effectiveness and residual activity of insecticide, fungicide and herbicide sprays. A pH stability additive is recommended.

Conductivity

Conductivity measurements represent the ability of water to conduct an electric current and are an indicator of the salinity, or mineral content, of water. Conductivity can be an indicator of runoff events, which could impact water quality and safety by introducing pathogens present in the runoff. These events typically cause a decrease in the specific conductance of a particular water source. Salinity is indicated by the total amount of solids (salts) dissolved in water, referred to as total dissolved solids (TDS). High salinity can result in nutrient toxicity and reduced water uptake by the plants. Conductivity is measured in micromhos per centimeter (µmhos/cm). For irrigation water, conductivity values range from excellent to poor:

- 0-500 µmhos/cm are considered excellent.
- 501-1,500 µmhos/cm are considered good.
- 1,501-3,000 µmhos/cm are considered fair.
- 3,001-5,000 µmhos/cm are considered poor.

Turbidity

Turbidity is a measurement of the amount of particulate matter — soil, minerals, sediment or algae, for example — suspended in water, making water cloudy or opaque. In surface water, turbidity can be influenced by groundwater runoff following heavy rainfall or heavy winds and increased temperatures during dry weather. Turbidity values are generally reported in Nephelometric Turbidity Units (NTU). Pure distilled water would have non-detectable turbidity (0 NTU). Measuring turbidity levels allows a farmer to monitor events that may impact the safety of the surface water source. An increase in turbidity could indicate a runoff event from a large storm that could result in microbial contamination if the runoff passed through manure on pasture land or included septic overflow. The higher the turbidity levels, the more surface area of suspended particles available for bacterial growth, which could potentially increase contamination risk when used in crop production. Figure 2 shows varying turbidity levels. Currently no uniform guidelines exist for acceptable turbidity values for irrigation water, though it is good to monitor the turbidity so you know what is normal for your water source.

Figure 2. Varying turbidity levels in water (from left to right: 0, 200 and 1,500 NTUs).

Summary

The more you know about your surface water source, the easier it will be to make water management decisions that reduce food safety risks that may be present. Establishing a baseline of water quality for your water source allows you to recognize and correct problems if they arise. If test results exceed your standards, investigate where the source of contamination possibly originated by assessing any activities near the water source. Once the problem has been identified, determine the best corrective action to eliminate the issue (i.e. removing the cause of the contamination, treating the water through an inline injection, or finding an alternate water source). Retesting the water source is also an option since contamination may have occurred during sampling. Do not use the water until you know the problem has been corrected.

For more information and additional food safety resources, visit:

UT Food Safety
http://vegetables.tennessee.edu/food_safety.html

USGS Water Science for Schools
http://ga.water.usgs.gov/edu

http://ga.water.usgs.gov/edu/characteristics.html

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