

What to consider when submitting a soil sample

Choosing a microbial test involves careful consideration of the abilities and limitations inherent in the design and application of the method. It is fair to say that all methods and tests are imperfect, and even a well-designed method may be completely inaccurate when used in different application scenarios. Test method selection is an exercise of evaluating the scenario in which it will be used, and ultimately accepting some compromises to identify the best method for the situation. These compromises can range in significance but can include characteristics like accuracy, sensitivity, price, time, etc.

In 2023, California saw significant flood events around the state, including in agricultural production areas. With flooding comes the need to assess not just the hazards that may have come into a field due to the flood waters, but the risks associated with their introduction. [Updated guidance](#) from Subject Matter Experts (SMEs) following these floods informed the industry on how to go about soil sampling land impacted by flood events and provided new guidance on what organisms to test for. This method selection resource is intended to be used alongside the Western Growers, May 3, 2023 Bulletin, titled California Flooding Events Soil Sample and Testing. This bulletin included SME's updated guidance based on recent research and it directs what the industry should do to assess risk following a flood event in an agricultural field.

Soil Testing Background

Soil is a complex medium comprised of a wide diversity of microorganisms, chemical compounds, and inhibitory materials that can make microbial testing difficult. For flood water and food safety, SMEs recommend to evaluate soils impacted by flooding for generic *E.coli*, *Salmonella*, and pathogenic shiga-toxin producing *E.coli* (STEC/EHEC). Below, find a resource identifying methods currently offered by laboratories serving the Produce industry. Unlike other matrices, microbial testing on soil is less standardized and generally involves adaptations of methods used for water/wastewater testing, biosolids testing, and/or food testing. Users of any test method should be aware of the limitations of the method so that results can be interpreted relative to the test's ability. If using various methods to evaluate soils, users must be careful to directly compare results as they originate from different test systems with varying method assumptions and limitations.

Unlike water samples, soil samples must dislodge bacteria that are attached to soil particles to suspend them in buffer and/or medium that will then be used for detection or quantification. Soil type (e.g., clay, loam, silt, etc.) will impact how easily bacteria can be dislodged from the particles, and labs may perform sample preparation differently between labs and samples. Test users should inquire with the lab on the preparation method to know how the sample will be prepared/homogenized, how many grams of soil will be tested, what dilutions will be made, and if the results will be reported on a wet or dry soil basis. Methods and modifications should be validated by the performing laboratory to ensure acceptable performance criteria of the method on the soil matrix.

Soil Test methods reported available at common Produce testing labs:

Method	Method reference	Targets	Output	Test designed for:	Modification of original method scope?
Standard Methods for Examination of Water & Wastewater (SMWW) [included IDEXX Colilert & Quanti-tray 2000]	9221, 9222	<i>E.coli</i> , Coliform, fecal coliform	MPN or CFU/ml	Water, wastewater	Yes, soil is not an included matrix for these methods' validations. Additional dilutions and temperature modifications may need to be made.
EPA 1681: fecal coliforms in sewage sludge (biosolids) using A-1 medium	EPA 1681	Fecal Coliform	MPN/g or ml	Biosolids	Yes, soil is not an included matrix for this method's validation
FDA BAM Chapter 4: Enumeration of <i>E.coli</i> and Coliform Bacteria	BAM Chapter 4	<i>E.coli</i> , Coliform	MPN/g or ml or CFU/g	Food & Beverages, Water	Yes, soil is not an included matrix for this method's validation. Additional dilutions may be needed due to particulate, and temperature modifications made if selecting for fecal coliform/thermotolerant coliform
EPA 1603: <i>E.coli</i> in water by membrane filtration using modified membrane-thermotolerant <i>E.coli</i> Agar (mTEC)	EPA 1603	<i>E.coli</i>	CFU/g or ml	Water, disinfected wastewater	Yes, soil is not included in the method's scope.
EPA 1604: Total Coliforms and <i>E.coli</i> in water by membrane filtration using a simultaneous detection technique (MI medium)	EPA 1604	<i>E.coli</i> , Coliform	CFU/g or ml	Water, potable water (could be used for recreational water, soil, runoff, sludge)	No. Method was designed for potable water, but the method scope of does reference it could be used on matrices including soil, runoff, or sludge.
3M Petrifilm - Rapid <i>E.coli</i> & Coliform	AOAC 2018.13, MicroVal 2017LR76	<i>E.coli</i> , Coliform	CFU/g or ml	Food, Beverages, facility surfaces	Yes, soil is not an included matrix for this method's validation. Additional dilutions may be needed due to particulate, and temperature modifications made if selecting for fecal coliform/thermotolerant coliform
3M Petrifilm - <i>E.coli</i> & Coliform	AOAC 991.14, 998.08	<i>E.coli</i> , Coliform	CFU/g or ml	Food, Beverages, facility surfaces	Yes, soil is not an included matrix for this method's validation. Additional dilutions may be needed due to particulate, and temperature modifications made if selecting for fecal coliform/thermotolerant coliform
Hygiena BAX real-time PCR	AOAC-RI 2013.02, AOAC-RI 091301, AOAC-RI 121402)	<i>Salmonella</i> , STEC/O157, <i>Listeria monocytogenes</i>	Absence/Presence	Food, Beverages, facility surfaces	Yes, soil not included in official method validation.
Microbiologique <i>E.coli</i> O157, EHEC, STEC, <i>Salmonella</i>	AOAC-RI PTM 100701, AOAC-RI PTM 021201	<i>Salmonella</i> , STEC/O157, <i>Listeria monocytogenes</i>	Absence/Presence	Food, Beverages, facility surfaces	Yes, soil not included in official method validation.

Helpful links:

https://wga.s3.us-west-1.amazonaws.com/science/2023/wg_science_34114_23_flood-white-paper_prod.pdf

<https://www.idexx.com/en/water/water-products-services/colilert/>

<https://www.standardmethods.org/action/showTopic?taxonomyUri=part&topicCode=part9000>

https://www.epa.gov/sites/default/files/2015-08/documents/method_1681_2006.pdf

<https://www.fda.gov/food/laboratory-methods-food/bam-chapter-4-enumeration-escherichia-coli-and-coliform-bacteria>

https://www.neogen.com/categories/microbiology/petrifilm-rapid-e-coli-coliform-count-plates?utm_medium=redirect&utm_source=vanity-url&utm_campaign=www.3m.com/3M/en_US/p/d/b40004013/

<https://www.neogen.com/categories/microbiology/petrifilm-rapid-e-coli-coliform-count-plates/?min=700002281>

<https://www.hygiene.com/food-safety/pathogen-detection>

https://www.epa.gov/sites/default/files/2015-08/documents/method_1603_2009.pdf