e-GRO Edible Alert

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Volume 10 Number 4 March 2025

# A Produce Safety Primer: Selecting Sanitizers to Control Human Pathogens

*Hydroponic systems can harbor pathogens that cause plant diseases and human illness. This alert focuses on using sanitizers to prevent contamination from human pathogens in growing environments.*

Human pathogens can be introduced into a growing system through irrigation water, growth amendments or additives, human contact, the intrusion of animals, postharvest wash water, and contaminated tools or surfaces, to name a few sources. While the risk of *Listeria*, *Salmonella*, and *E. coli* contamination in hydroponic systems is real and documented, a grower's adherence to incorporating good agricultural practices is crucial to prevent contamination. Once consumed, these pathogens can cause mild to severe human illness and sometimes death.

Image 1. Surfaces in NFT systems such as nutrient reservoirs, channels, channel covers, growing media, plant roots, leaves, and drain lines can harbor plant and human pathogens.

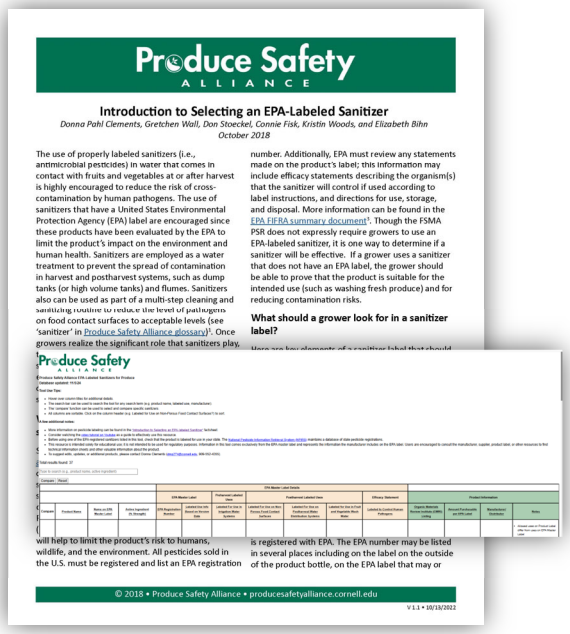
Research published by Ohio State University Extension's Produce Safety Team members (Ilic et al, 2022) illustrated how *Listeria monocytogenes* and *Salmonella* Typhimurium pathogens survived in a nutrient film technique (NFT) system. *Salmonella* bacteria survived in the nutrient solution, on rockwool cubes, and on lettuce roots following a simulated sporadic and extreme contamination event. Bacteria were detected on the surfaces of NFT system components at harvest - including lettuce leaves (Image 1). This study illustrates that human pathogens can transfer to the growing crop via splashing and/or close contact with contaminated nutrient solution.

What practices can help limit contamination from human pathogens? One concrete practice growers should utilize to prevent contamination from human pathogens is proper sanitation of all nonporous food contact surfaces, including containers, channels, greenhouse floors, benches, work areas, tools, etc.

Many sanitizers are labeled to eliminate pathogens that cause plant disease from greenhouse surfaces or irrigation systems. Others are specifically labeled to kill pathogens that cause human illness. How do you identify which sanitizer to use? The Produce Safety Alliance has developed several helpful resources for hydroponic growers when selecting sanitizers (Image 2).

The first is a fact sheet on Selecting an EPA-labeled Sanitizer. This document provides a good overview of sanitizer labels and what information is important to consider.

The second resource is the EPA-labeled Sanitizers for Produce spreadsheet**. This tool provides a complete list of federally labeled sanitizers for use in growing, harvesting, and packing fresh produce. The list can be sorted and products selected for comparison. The spreadsheet also indicates a column for sanitizer use – such as in irrigation water, on non-porous food contact services, postharvest water distribution systems, fruit and vegetable wash water – and denotes whether products are labeled to control human pathogens.


Produce Safety ALLIANCE

Introduction to Selecting an EPA-Labeled Sanitizer

*Donna Pahl Clements, Gretchen Wall, Don Stoeckel, Connie Fisk, Kristin Woods, and Elizabeth Bihn*
*October 2018*

The use of properly labeled sanitizers (i.e., antimicrobial pesticides) in water that comes in contact with fruits and vegetables at or after harvest is highly encouraged to reduce the risk of cross-contamination by human pathogens. The use of sanitizers that have a United States Environmental Protection Agency (EPA) label are encouraged since these products have been evaluated by the EPA to limit the product's impact on the environment and human health. Sanitizers are employed as a water treatment to prevent the spread of contamination in harvest and postharvest systems, such as dump tanks (or high volume tanks) and flumes. Sanitizers also can be used as part of a multi-step cleaning and sanitizing routine to reduce the level of pathogens on food contact surfaces to acceptable levels (see 'sanitizer' in Produce Safety Alliance glossary)[1]. Once growers realize the significant role that sanitizers play, will help to limit the product's risk to humans, wildlife, and the environment. All pesticides sold in the U.S. must be registered and list an EPA registration number. Additionally, EPA must review any statements made on the product's label; this information may include efficacy statements describing the organism(s) that the sanitizer will control if used according to label instructions, and directions for use, storage, and disposal. More information can be found in the EPA FIFRA summary document[2]. Though the FSMA PSR does not expressly require growers to use an EPA-labeled sanitizer, it is one way to determine if a sanitizer will be effective. If a grower uses a sanitizer that does not have an EPA label, the grower should be able to prove that the product is suitable for the intended use (such as washing fresh produce) and for reducing contamination risks.

**What should a grower look for in a sanitizer label?**

is registered with EPA. The EPA number may be listed in several places including on the label on the outside of the product bottle, on the EPA label that may or

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Image 2. The Produce Safety Alliance factsheet and spreadsheet on EPA-labeled Sanitizers are two helpful resources for growers when selecting sanitizers.

**Please note, that not all sanitizer products are labeled for use in every state. Growers need to verify that a particular product is also registered in the state where the application will be made. This can be accomplished by searching the National Pesticide Information Retrieval System (NPIRS). At this time, only 32 of 50 states participate in this database system (Image 3). For those states not participating, please check with your state Department of Agriculture for registration and label verification.

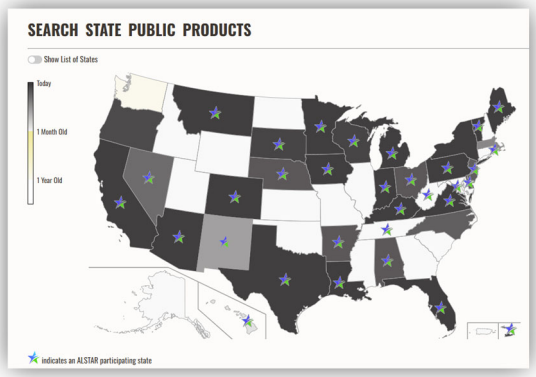


Image 3. The NPIRS database provides label searches for 32 of 50 US states. Participating states are shaded.

While these resources help determine how and when sanitizers can legally be used in hydroponic production – they fail to provide information on whether sanitizers positively or negatively affect the growth and quality of edible crops grown. A follow-up study to the previously

referenced 2022 OSU study on the survival of Listeria and Salmonella on NFT surfaces was conducted and published by Mensah et al,(2024). In this study, commonly used greenhouse sanitizers were evaluated in NFT production of lettuce and basil. Three types of sanitizers (chlorine, peroxyacetic acid, and quarternary ammonia compounds) were evaluated for their ability to eliminate *Salmonella* bacteria from the reservoir, channel top cover, channel, and main drain line surfaces. Sanitizers were also added to the NFT solution five days following the transplant of seedlings to determine the effects on yield and quality. Overall results from this paper are summarized below (Table 1).

**Table 1. The Effect of Sanitizer on *Salmonella* Elimination from NFT Surfaces and Lettuce and Basil Fresh Weight at Harvest**

| Sanitizer Treatment | Sanitizer Product and Concentration | Elimination of *Salmonella* from NFT Surfaces | | Effect of Sanitizer Addition on Fresh Weight at Harvest (Added 5 d Post-transplant) | |
|---|---|---|---|---|---|
| | | Contact Time | 100% Elimination from Surfaces | Lettuce: *Lactuca sativa* cv. Rex | Basil: *Ocimum basilicum* cv. Genovese |
| Water (control) | | n/a | No | ~160 g/plant | ~95 g/plant |
| Chlorine | Bleach: 100 ppm | 10 min | No | Lower | Same |
| | Bleach: 200 ppm | | | Lower | Lower |
| Peroxide-peroxyacetic acid (PPA) | Zerotol 5% | 10 min | Yes | Plants died within 5 days | |
| | SaniDate 12.0: 100 ppm | 5 min | No | Not tested | |
| | SaniDate 12.0: 200 ppm | 5 min | Yes | Lower | Same |
| Quaternary ammonia compounds (QAC) | KleenGrow 2% | 10 min | Yes | Plants died within 5 days. | |
| | Green Shield 5% | | | | |
| | Virkon 1% | | | | |

Sanitizers are an important component to growing pathogen-free hydroponic produce. Additional work is needed to identify the extent sanitizers eliminate human pathogens and affect growth and quality of a wide range of hydroponically-grown species. These studies will help generate meaningful recommendations for producers.

**Resources**

Ilic, S.; Moodispaw, M.R.; Madden, L.V.; Lewis Ivey, M.L. Lettuce Contamination and Survival of *Salmonella* Typhimurium and *Listeria monocytogenes* in Hydroponic Nutrient Film Technique Systems. Foods **2022**, 11, 3508. https://doi.org/10.3390/foods11213508

Mensah, A.A.; Lewis Ivey, M.L.; Moodispaw, M.R.; Ilic, S. Effectiveness of Chemical Sanitizers against *Salmonella* Typhimurium in Nutrient Film Technique (NFT) Hydroponic Systems: Implications for Food Safety, Crop Quality, and Nutrient Content in Leafy Greens. Foods **2024**, 13, 1929. https://doi.org/10.3390/foods13121929

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