

Growing in the Dark: Illuminating Food Safety Blind Spots in Hydroponic Systems

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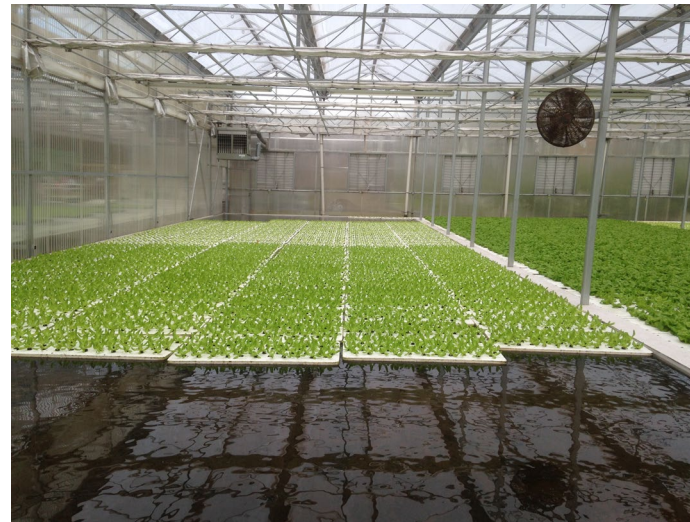
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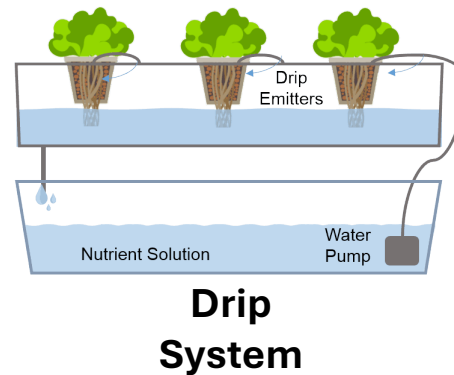
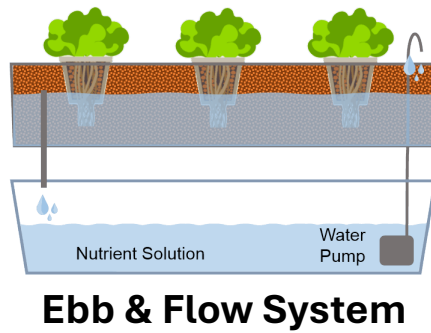
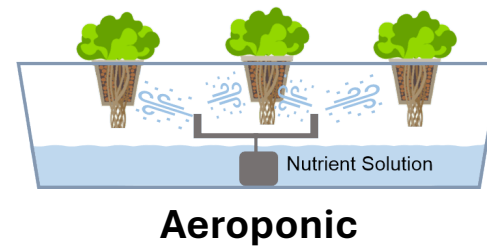
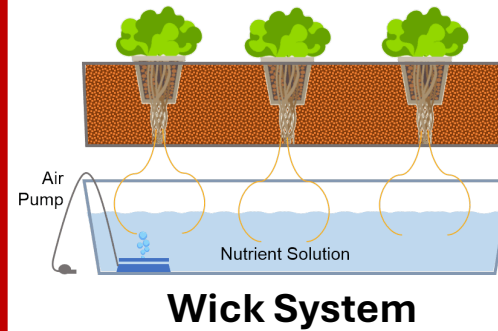
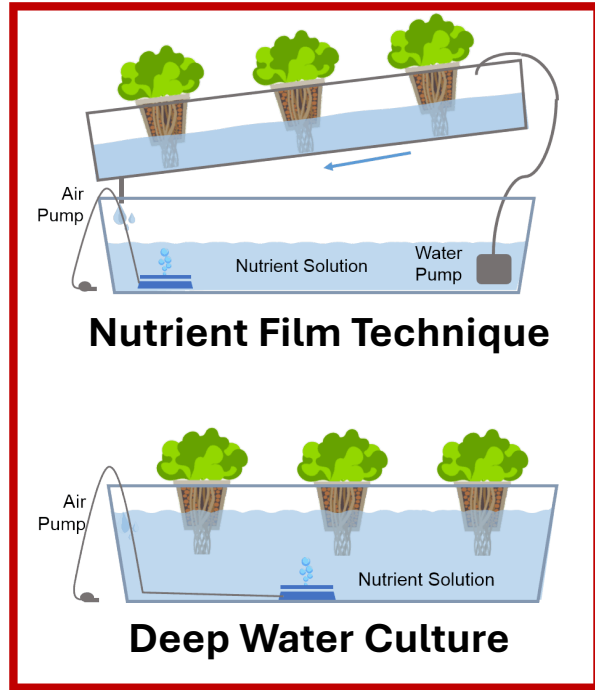


What is controlled environment agriculture [CEA]?

- A group of production systems that create a controlled environment to optimize horticultural practices and plant growth via technology-based approaches such as climate control, artificial lighting, precision irrigation, etc.



Hydroponic System Types:



What is “soilless substrate”?

- A soilless potting medium that is generally porous to retain aeration and moisture that the roots need to live and grow:
 1. Supply oxygen, nutrients, and water to plant roots
 2. Physically support the plant
- >18 soilless substrates to consider

Soil-free cultivation matrix

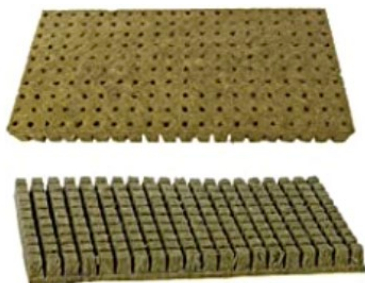
Solid substrate

Growing media

Soilless support matrix



Peat



Rockwool



Pine shavings



Oasis Horticultubes™



Coco coir



Leca clay





What do we *know* and what do we
need to know about indoor, soilless
production of leafy greens?

What does the published literature say?

1. Risk of microbial **contamination will vary during CEA production** depending on leafy green crop, soilless substrate, and system selection along with horticultural management practices.
2. Most studies focused on *Salmonella enterica* subsp. *enterica* (n=22) and Shiga toxin-producing *Escherichia coli* (n=23) compared to *Listeria monocytogenes* (n=12).
3. No clear answer regarding the primary drivers in **pathogen internalization risk** within CEA-grown leafy green crops.
4. Studies within commercial scale CEA production systems with a focus on microbial risks **are lacking**.
5. No studies have addressed **pathogen spread within the CEA built environment** (e.g., environmental monitoring, cleaning and sanitizing, etc.)

What do researchers and extension educators say?

Research Needs

L. monocytogenes
within indoor
soilless systems

Soilless Substrate
Selection and
Pathogen Control

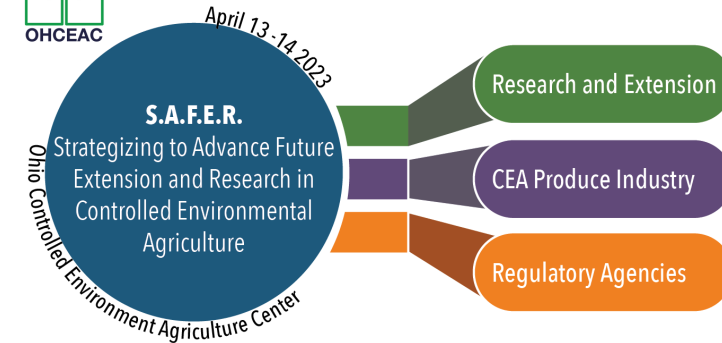
Hygienic Design
Principles/
Material Selection

Cleaning and
Sanitizing Best
Practices

Role of Microbial
Community in
System Function

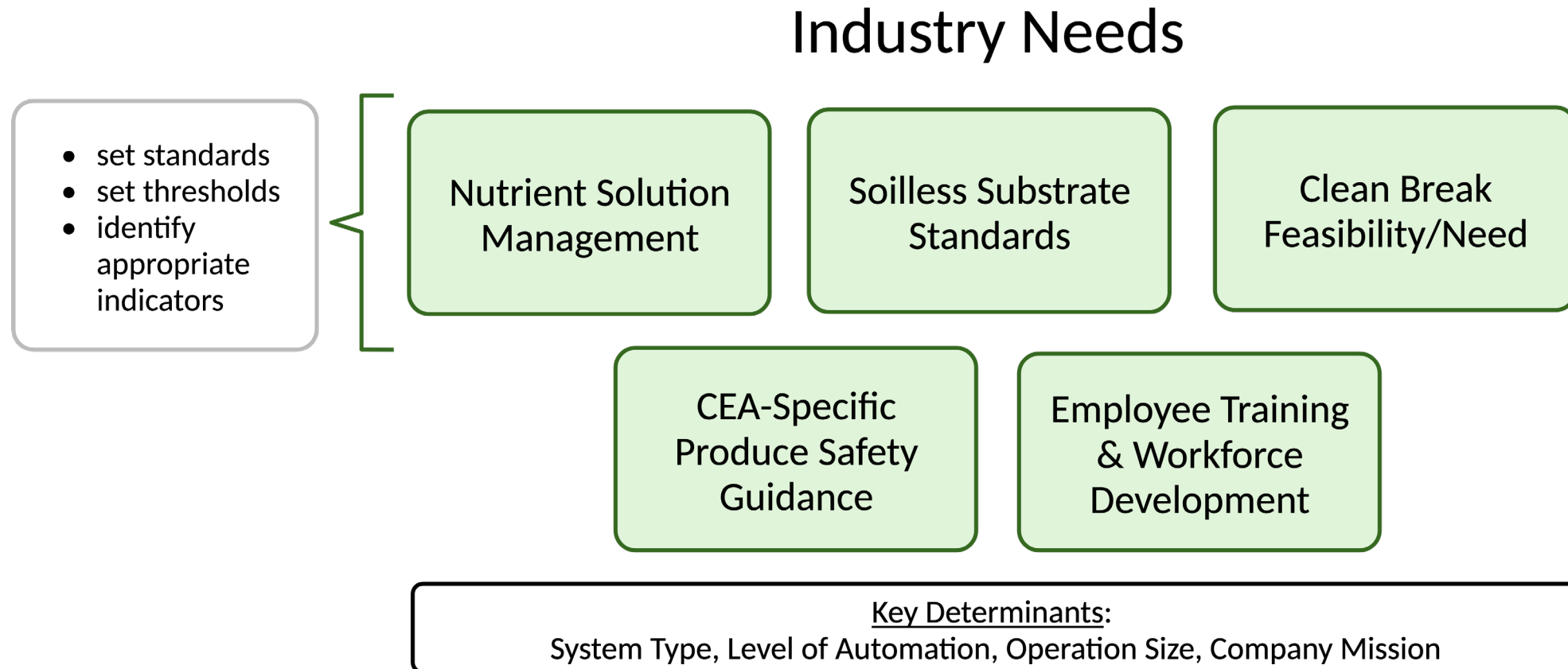
Key Determinants:

System Type, Level of Automation, Operation Size, Company Mission



What does the industry need?

Interviews with **25 indoor, soilless leafy greens operations** highlighted that:



What does the AFDO audience think?

Consider the materials provided:

1. Which of these system inputs are potential sources of pathogen contamination?
2. What additional information is needed to control these pathogen sources?
3. Where would you focus your efforts on food safety risk mitigation?



Address needs using an incremental approach via collaboration across industry, academia, and regulatory:

SHORT-TERM

- Utilize current risk assessment tools to identify uncertainty and variability in the data
- Implement environmental monitoring programs
- Standardization of definitions and terms for better communication

MEDIUM-TERM

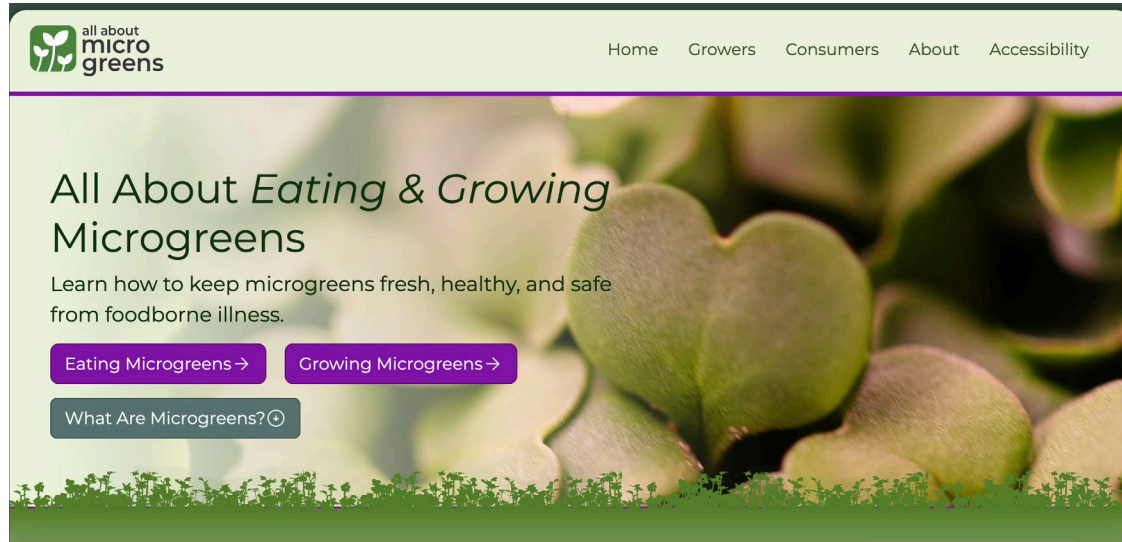
- Development of accessible food safety training materials
- Development of preventive measures, mitigation strategies, & corrective actions specific to production system type
- Define food safety requirements for input materials

LONG-TERM

- Determine the effect and possible use of non-chemical treatments that balance system and plant health
- Investigate pathogen control via manipulation of physicochemical and microbiome characteristics of nutrient solutions

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Specific Food Safety Resources/Initiatives



all about microgreens

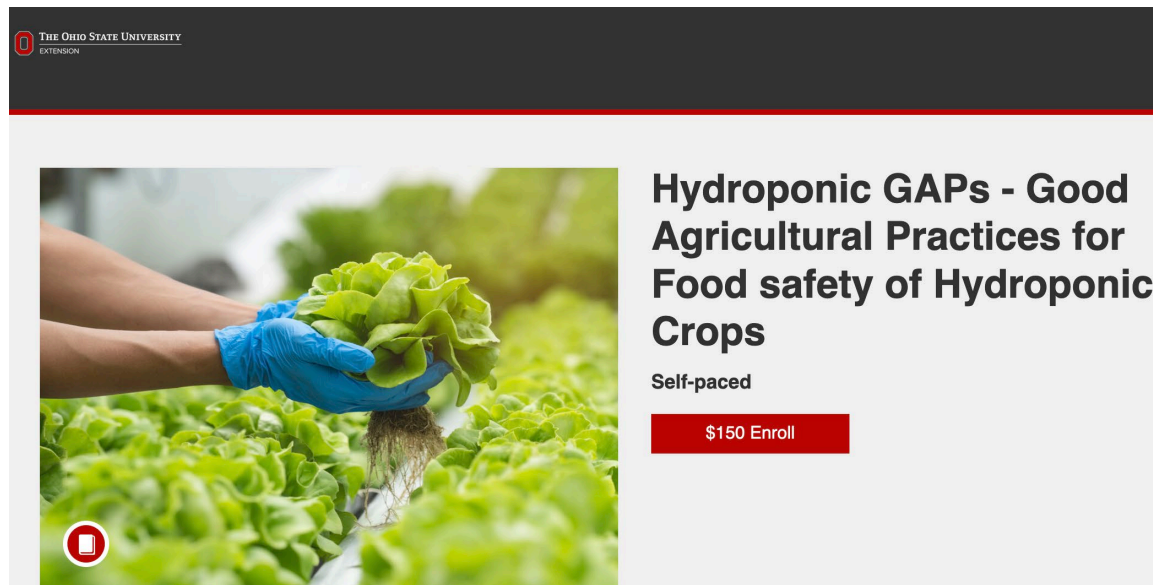
Home Growers Consumers About Accessibility

All About *Eating & Growing* Microgreens


Learn how to keep microgreens fresh, healthy, and safe from foodborne illness.

[Eating Microgreens →](#) [Growing Microgreens →](#)

[What Are Microgreens? ⓘ](#)



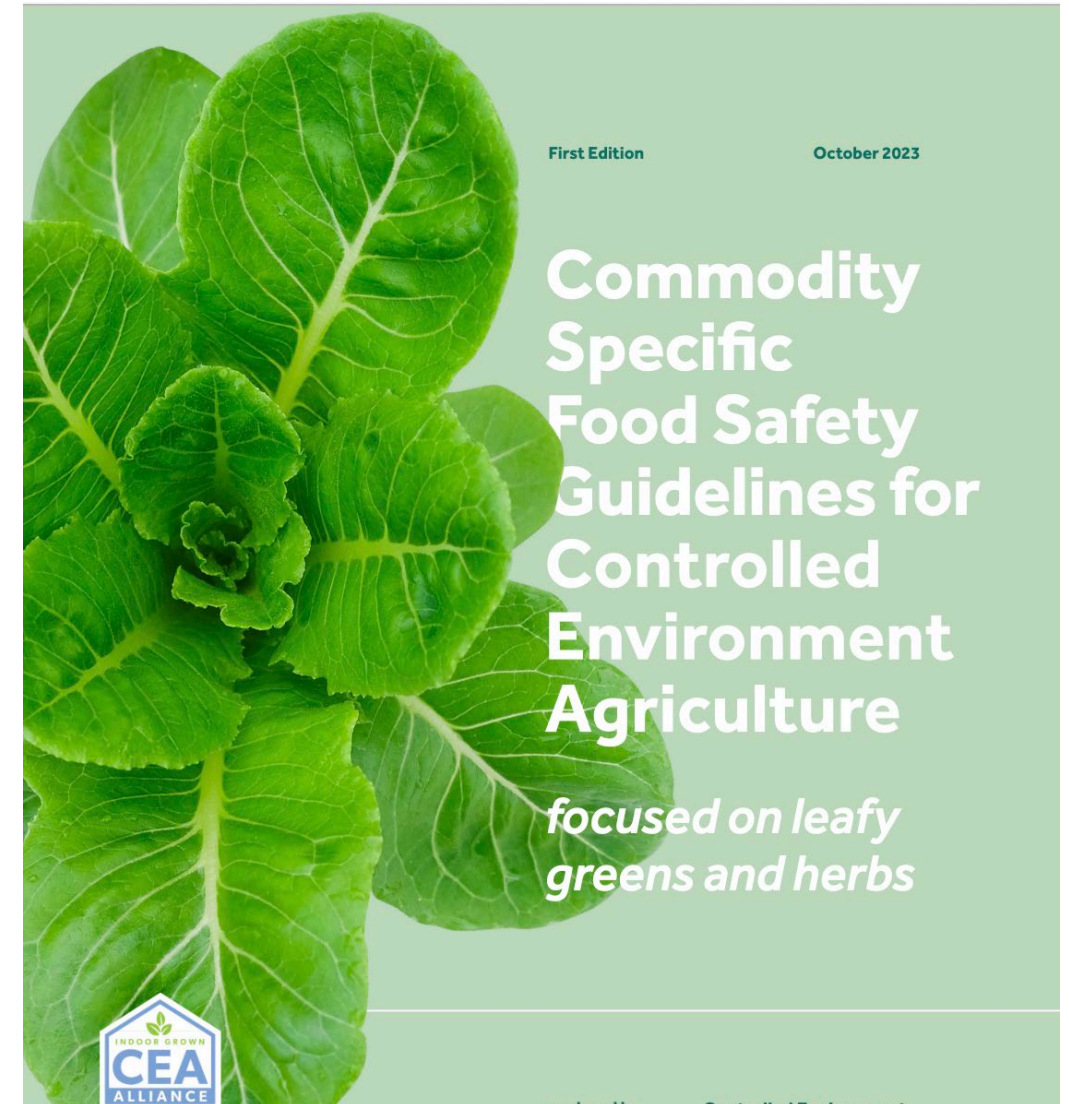
THE OHIO STATE UNIVERSITY
EXTENSION



Hydroponic GAPs - Good Agricultural Practices for Food safety of Hydroponic Crops

Self-paced

\$150 Enroll



First Edition October 2023

Commodity Specific Food Safety Guidelines for Controlled Environment Agriculture

focused on leafy greens and herbs

INDOOR GROWER CEA ALLIANCE



Hydroponics and Aquaponics Existing Resources, Current Work & Plans



go.uvm.edu/ponics



Factsheets Available

- Cleaning and Sanitizing
- Fish Health and Handling
- Harvest and Postharvest Handling
- Personal Health and Hygiene
- Wildlife and Domesticated Animals

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