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FEATURES

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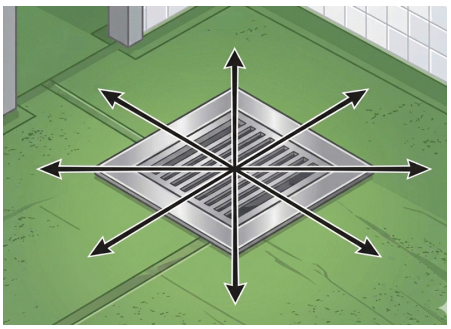
Environmental Monitoring 101

Kellie Worrell

Environmental Monitoring Programs (EMPs) are a vital component of food safety within the food supply chain, and are typically put into place in operations where postharvest handling of ready-to-eat fruits and vegetables occur, such as packinghouse or processing facilities.

In Controlled Environment Agriculture (CEA), these activities may occur in the same facility as the growing operations, with varying degrees of separation between the different processes. The primary purpose of an EMP in post-harvest handling settings is to verify that pathogens (or indicator organisms) are effectively controlled in the areas of the facility that could potentially pose a risk of contamination to the product(s) being handled. In indoor growing, however, environmental monitoring has taken on a much broader meaning to include the monitoring of a range of factors that affect crop quality and quantity.



What's the difference?

Environmental Monitoring in CEA growing operations is likely to include the ongoing measurement of light, temperature, humidity, nutrient elements and concentrations (in growing medium or added to water), water quality, carbon dioxide and even pests. Thanks to the Internet of Things (IoT), much of this monitoring can be automated. Digital humidistats, for example, can constantly monitor humidity and automatically adjust water vapor levels within the growing environment while maintaining records of the exact conditions at every moment.

Floor drain vectors.

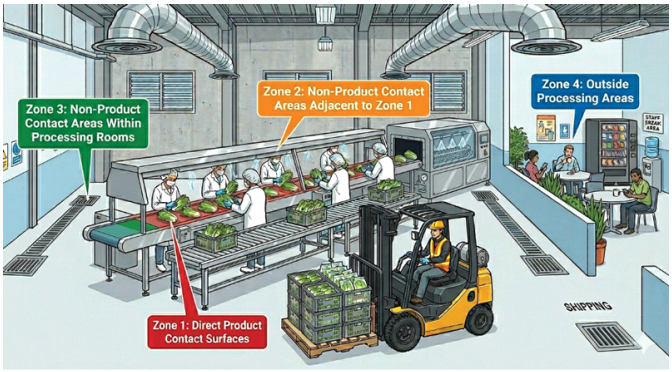
This monitoring comes with an upfront equipment cost, especially as the process becomes more automated, but the payoff in yield may offset that initial expense in a reasonable timeframe. When it comes to environmental monitoring in CEA growing activities, data is key! The more you know about the exact growing conditions compared to the corresponding output, the better you can continuously improve both the quality and quantity of your crop(s). Additionally, you can avoid wasting resources that aren't providing returns, which saves in expense and is also environmentally responsible.

EMPs in postharvest handling activities take on a somewhat different focus. Their purpose is to ensure that the culmination of cleaning and sanitation practices, Good Agricultural Practices (GAPs), sanitary design,

and other food safety efforts are effectively controlling those pathogens that pose a risk to the product(s) being handled. At the heart of an EMP in these settings is the act of swabbing surfaces to “seek and destroy” pathogens. Commonly used swabbing equipment includes sponge-on-a-stick swabs, which are composed of hydrated sponges often attached to a plastic handle, or tip-style swabs that look like oversized Q-tips but are made of synthetic materials. Both types are used to swab surfaces such as floors, equipment and even tiny crevasses.

The essential questions that need to be addressed by your EMP are:

- What am I looking for?
- Where am I looking?
- When am I looking?
- What do I do if I find something?



Let’s dive deeper

A robust EMP should include formal documentation of the analytical process used to assess each of these questions. There must be scientific justifications for the decisions being made. The protocol of prescribed activities must be clearly detailed so that they can be consistently carried out. Recordkeeping is another vital component—record the measurement activities, the results and any actions that were taken in response.

Packhouse zones.

What am I looking for? refers to the target pathogen or indicator organism of concern that you’re trying to prevent. This should be justified based on historical outbreak data for the crop(s) being grown and/or handled or for operations with similar processes. Most commonly, EMPs are trying to detect *Escherichia coli* (*E. coli*), *Listeria monocytogenes* (or *Listeria spp.* as an indicator) or Salmonella before they can contaminate the food.

Where am I looking? refers to the Zonal Approach of prioritizing environmental monitoring resources based on the risk of contamination. In the Zonal Approach, the facility is divided into four zones based on the risk they present to the food being handled. Zone 1 is the highest risk and includes direct product-contact surfaces (such as conveyer belts, utensils and employees’ hands or gloves). Zone 2, the non-food-contact surfaces near Zone 1 (such as the framework of machines, buttons and drip pans), still presents a critical priority. Zone 3 is the remainder of surfaces in the general handling area (including floors, walls, drains, vents and forklifts), which can still be a high priority to prevent pathogen movement. Finally, Zone 4 is comprised of areas removed from the handling area (such as hallways, breakrooms and offices), which are a lower priority.

When am I looking? is a complicated question that’s specific to each operation. This can refer to timing, such as prior to shifts or two hours into each shift. This can also refer to frequency, such as pre-season, monthly or per batch. The timing and frequency will likely vary by zone. Zone 1 would potentially need to be

sampled at the highest frequency. A detailed schedule needs to be documented with rotating testing locations in each zone, with a prescribed frequency for each, as well as the timing during which the swabbing should be conducted.

What do I do if I find something? is the most pivotal question the EMP must address. All the testing in the world does no good if it doesn't drive actions that keep our food safer. Conversely, the detection of an indicator pathogen doesn't necessarily mean that the product is contaminated. Nonetheless, if the presence of any pathogens or indicators is detected, Corrective Actions should be taken. First, the affected area and surrounding equipment must immediately undergo intensive sanitation. "Vector swabbing," the act of taking additional swabs around the location of the positive site in a "starburst" pattern, is recommended to help locate the source of the pathogen. A Root Cause Analysis should then be conducted to determine why the contamination occurred. Only then can effective procedures be put in place to reduce the risk of this occurring in the future. Finally, a verification step is needed to ensure that the detected pathogen has been eliminated. Three consecutive days of negative results should be achieved before returning to the normal monitoring schedule.

For all Environmental Monitoring efforts, knowledge is power. The more information (data) you gather about the environment in which you're growing, handling and/or processing products, the better you're able to minimize the risks of contamination and do your part to protect our food supply. **IG**

Kellie Worrell has an extensive background in food safety and agriculture. She's the Senior Certification Manager for GLOBALG.A.P. and PrimusGFS at EAGLE Certification Group.

> **More Safety Info**
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> In case you missed it, Kellie wrote about food safety certifications in the Autumn issue of *Inside Grower*. She has an article in the Spring 2027 issue on creating effective water risk assessments, so watch for that in the next issue.