



Guide to Identifying Food Safety Hazards in Greenhouse Systems

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Overview

According to the United States Department of Agriculture 2012 Census of Agriculture, sales from greenhouse-grown food crops equaled around \$800 million in the U.S. Crops grown included tomatoes, lettuce, cucumbers, peppers, and berries, with hydroponic production operations making up about 64% of the total production (cwt) (USDA Census of Agriculture, 2012). Demand for greenhouse-grown produce continues to increase, providing growers with unique opportunities to tap into this expanding market. Although greenhouse systems provide a more protected environment than field-grown systems, it is important to understand the unique food safety risks and possible sources of contamination when growing produce in these systems. Identifying food safety hazards are necessary to implementing practices that reduce the risk of contamination during the pre-plant, production, harvest, and post-harvest handling stages. Use the checklist below to guide you in asking important questions targeting possible risks at each of the greenhouse system stages.

General

- Have all workers been trained in proper health, hygiene, and produce handling practices and policies for each of the stages; and are all procedures/SOPs performed being regularly documented (recordkeeping)?
- If any contamination concern occurs, what are the corrective actions to mitigate these concerns (remember to document them: describing the situation, date of occurrence, and action(s) taken)? For more information on understanding and identifying further food safety risks, visit Virginia's Fresh Produce Food Safety website: <http://www.hort.vt.edu/producesafety/>.

Pre-Plant Stage

- What is the crop being grown? Are there any risks known to be associated with this crop?
- What is the seed source if you are propagating transplants from seeds?
- What substrate will be used for seed starting? Is it a soil-less substrate? If not, do you know the source, composition, and process used to make the media? For example, if rockwool is used, have the tools used to cut the rockwool been cleaned and sanitized?
- Are the growing containers new, or have the used containers been cleaned and sanitized?



- Is the water used for irrigating the seedlings from a potable source?
- Are there growing conditions that may pose a food safety risk (for example, high humidity, darkness, physical proximity to other hazards like chemicals used for nutrient solutions)?

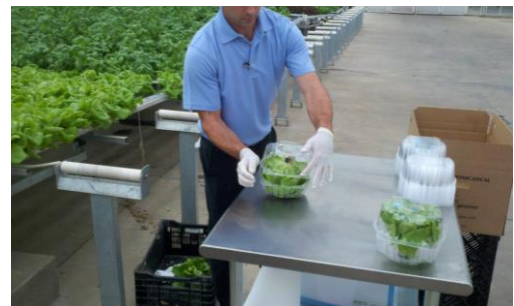
Production Stage

- What type of greenhouse production system is being used (for example, in-ground beds, benches, or hydroponic)?
- If plants are being grown in the ground, will they be grown on plastic or directly in the soil?
 - If growing in the soil, are any amendments being added?
 - If so, do these amendments contain raw manure or composted manure?
 - If so, do you have a record of the source/manufacturer of the amendment and process used to make it?
 - If so, was the amendment applied with the recommended interval between planting and harvest dates?
- If plants are being grown in containers on benches, what substrate is used?
- If a hydroponic system is used, what is the specific type (for example, nutrient film technique (NFT), floating raft, vertical stack, aeroponic)?
 - Are channels, rafts, and pots cleaned and sanitized between crop rotations; and stored to minimize contamination?
- What is the source of irrigation water? Is the irrigation source tested for *Escherichia coli* annually?
- For hydroponic nutrient solutions, are concentrated nutrients and acids stored in such a way as to prevent cross contamination and spillage?
- Does the greenhouse facility have overhead lights? If so, are lights covered to prevent shattering/breaking over crop growing areas?
- Are tools and materials stored in the greenhouse production area; are they located away from growing areas to prevent contamination?
- Are rodent/fly traps placed around the entrances and inside perimeter of the greenhouse? If so, do traps contain any poison bait that could be a risk? Is there a schedule to monitor traps)?
- Are domestic animals prevented from entry into the greenhouse, head-house, and packing areas?



Harvest Stage

- Are harvesting tools, carts, and bins cleaned and sanitized prior to use? If so, are they properly stored to prevent re-contamination?



- If harvested crop is packed directly into containers and boxes in the production area, are packing materials new? Are all packing containers and boxes stored to protect them from contamination?
- If harvested crop is re-packed in a separate area from greenhouse production, is there a way to provide traceability of the crop and growing location from the greenhouse to the packing area (i.e. packing slip or labeling system)?

Post-Harvest Handling Stage

- Have packing surfaces been cleaned and sanitized prior to packing the produce?
- If produce is washed prior to packing, has wash water been tested to ensure potability?
 - If so, is testing conducted at least annually (or more regularly as needed)?
 - Is washing equipment cleaned and sanitized prior to the wash step?
 - If sanitizer is used, is it labeled for use with produce and food contact surfaces, and are labeled rates being used?
- What types of packing materials are used (for example, clamshells, cardboard boxes, bags, foam, corrugated fiberboard, among others)? Are these properly stored to prevent contamination from pests and or other hazards?
- Are live rodent/fly traps placed in the packing area? Are these regularly monitored to track pest pressures?
- Once packed, how is the product stored?
 - For crops requiring refrigeration, are they stored in coolers, walk-in cold room, among others? Are cold storage facilities cleaned, organized, regularly maintained, and identified with proper signage?
 - Is the cooler used for storing non-produce, such as meats or other foods and items that could cross contaminate the produce?
 - Is storage temperature monitored to ensure that it is maintained consistently to preserve produce quality? Are thermometers regularly calibrated? How are thermometers calibrated?
- How is the product transported to the marketplace?
 - Is the cold chain maintained?
 - Is the transport vehicle regularly cleaned to prevent cross contamination?



References

USDA Census of Agriculture. 2012. Available from:
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