

Best Practices for Fresh Produce Food Safety

Good Agricultural Practices, Worker Hygiene, and Sources of Contamination



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The 2011 Food Safety Modernization Act (FSMA) mandates science-based approaches to evaluating food safety risks on produce farms and in food processing facilities. The suite of new regulations issued under the law includes “Standards for the Growing, Harvesting, Packing, and Holding of Produce for Human Consumption,” commonly referred to as the Produce Safety Rule. The FSMA Produce Safety Rule grants new authority to the U.S. Food and Drug Administration (FDA) to develop and enforce farm food safety standards, known as Good Agricultural Practices (GAPs), for commercial growers, harvesters, and packers of fruits, vegetables, and mushrooms intended or likely to be eaten raw. Unlike current commercial third-party GAPs audit program, a written food safety plan is not required under the Produce Safety Rule. However, microbial metrics are mandated for reducing food safety risks related to crop contact with agricultural water, raw and composted animal manure, and domestic and wild animals; worker health and hygiene practices; and harvest and postharvest sanitation.

The Produce Safety Rule applies only to those farms that are not exempt (for reasons of scale and marketing channels) and that do grow produce covered under the rule. For those farms, the Produce Safety Rule specifically mandates farm food safety training that is conducted in a manner that is easily understood by those workers being trained. Training is required at two levels. At least one supervisor

or responsible party on the farm must have successfully completed food safety training at least equivalent to that received under standardized curriculum recognized as adequate by the FDA. The Produce Safety Alliance (PSA) was charged by FDA to develop a standardized GAPs curriculum against which all others are benchmarked (see producesafetyalliance.cornell.edu).

The regulation further states that for these farms, all personnel who handle covered produce or food-contact surfaces must receive farm food safety and hygiene training upon hiring and at least once annually. FDA has stated that traditional training activities may not work for all groups, and there are certain instances in which alternative curricula and training deliveries may be appropriate.

The purpose of this training booklet is to help food safety managers who attended the Food Safety Modernization Act’s Produce Safety Rule training to communicate the knowledge to others on the farm. This booklet includes sections on the topics most commonly needed for worker training:

- Introduction to Good Agricultural Practices (GAPs) (pp. 2–8)
- Worker Health and Hygiene (pp. 9–18)
- Preventing Contamination Before, During, and After Harvest (pp. 19–24)

These sections can be used individually or as a series as a basis for training workers. For this reason, some information is covered in more than one section.



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INTRODUCTION TO GOOD AGRICULTURAL PRACTICES (GAPs)

Why Are GAPs Important?

Keeping produce safe is important because it affects everyone in the food system:

- **Consumers.** We don't want people to get sick or die because of food they eat.
- **Businesses that buy and sell fresh produce.** We don't want these businesses to have to throw away a lot of food that might be contaminated.
- **Farmers.** We don't want farmers to be stuck with unsold crops because consumers are afraid to buy them.

Foodborne Illness in the United States

- One in six people in the United States get sick from eating contaminated food each year.
- 48 million cases of foodborne illness are reported each year.
- 128,000 hospitalizations occur from contaminated food.
- 3,000 deaths result from foodborne illness each year.

It's difficult to determine exactly how many people become ill each year from eating food. Most cases are considered just minor bouts of the "stomach flu" or indigestion. However, some cases are serious enough to require hospitalization or even cause death.

Microorganisms of Concern in Fresh Produce

Foodborne illnesses are caused by microorganisms that get into our digestive systems when we eat contaminated food. Since these microorganisms are too small to see with the naked eye, you need a microscope to see them.

Three types of microorganisms cause foodborne illnesses: bacteria, viruses, and parasites. Some examples are:

- **Bacteria:** pathogenic *E. coli*, *Salmonella*, *Shigella*, *Listeria*
- **Viruses:** Hepatitis A, *Norovirus*
- **Parasites:** *Giardia*, *Cryptosporidium*, *Cyclospora*

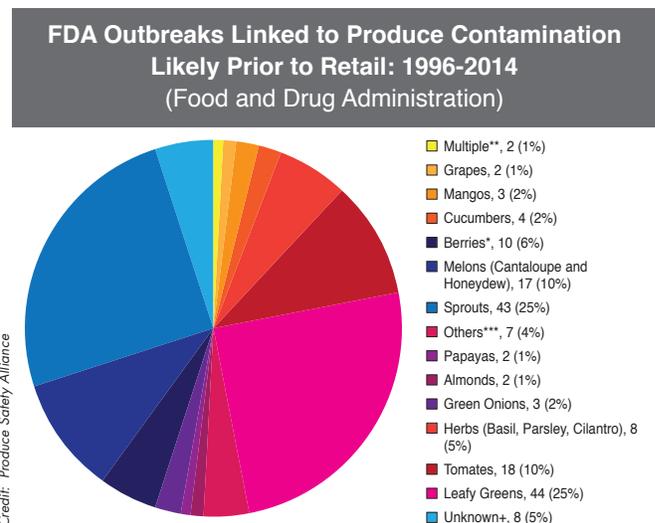
Note that not all strains of *E. coli* make us sick. Beneficial strains of *E. coli* in our intestinal tracts are very good for us. It is important to understand that:

- These microorganisms are very small.
- They can hide on the surface of fruits and vegetables.
- If we eat fresh or raw fruits or vegetables that are contaminated with these microbial pathogens, we can get sick—sometimes very sick.

Fresh Produce Outbreaks and Recalls

We see foodborne illness outbreaks with many kinds of foods, including dairy, meats, and prepared foods. This publication will focus on fruits and vegetables, specifically the ones we eat without cooking.

The chart below shows the number of foodborne illness outbreaks associated with fresh produce from 1996 to 2014.



According to a recent report from the U.S. Congressional Research Office, the number of single- and multistate outbreaks of foodborne illness associated with fresh produce between 1998 and 2016 ranged from 30 to 60 per year and sickened from 900 to nearly 3,000 per year. While most of the outbreaks were caused by contaminated leafy greens (lettuce, spinach, other salad greens) and sprouts (alfalfa or bean), a lot of other fruits and vegetables have also caused outbreaks, such as tomatoes, berries, herbs, cucumbers, green onions, and mangoes, among others.

Let's look at some of the most significant foodborne illness outbreaks associated with fresh produce from 2011 through 2014.

2011

- ***E. coli* O157:H7 on strawberries in Northwest Oregon.** The strawberries were resold to many different farm stands, so they became very difficult to track even after the strawberries were known to be the source of the *E. coli* contamination. Fifteen people became ill and one death occurred as a result of this outbreak.
- ***E. coli* O14:H4 on fenugreek sprouts in Europe.** We saw a huge outbreak from a pathogenic strain of *E. coli* that resulted in 810 people becoming ill and 39 deaths. It took investigators a long time to track the source, which ended up being seeds of the herb fenugreek that were used to grow sprouts. Because people did not know the source of the contamination for quite some time, a lot of farmers lost crops of lettuce, tomatoes, and cucumbers because people were afraid to buy them.
- ***Listeria monocytogenes* on cantaloupes in Colorado.** This big outbreak was caused by the bacterium *Listeria* and caused more than 130 illnesses and 28 deaths.



2012

- ***E. coli* O26 on raw clover sprouts grown in the United States.** This outbreak resulted in 29 people becoming sick.
- ***E. coli* O104:H4 on mangoes grown in Mexico.** While no deaths occurred, 127 people became ill and 33 were hospitalized.
- ***E. coli* O157:H7 on spinach and spring mix grown in Massachusetts.** This outbreak caused 28 people to become ill.
- ***Salmonella* on cantaloupe in Indiana.** As a result of this outbreak, 261 people became ill, 94 people were hospitalized, and three people died. In fact, this farm went bankrupt and its farmers served time in jail for negligence.

2013

- ***Salmonella* spp. on cucumbers grown in Mexico.** Seventeen people were hospitalized.
- **Hepatitis A on pomegranate seeds grown in Turkey.** This outbreak led to 162 people becoming sick and 71 people being hospitalized.
- ***E. coli* O157:H7 on prepackaged salad mix.** While the source of this outbreak is unknown, it resulted in 33 illnesses.
- ***Cyclospora* on cilantro grown in Mexico.** This outbreak resulted in 631 people becoming sick.

2014

- **Mung bean sprouts grown in Illinois and Michigan.** This outbreak caused five cases of listeriosis that required hospitalization and two deaths. FDA inspection and testing

of the facility where the sprouts were grown yielded *L. monocytogenes*-positive isolates from the sprouts, the irrigation water used from sprout production, and the growing environment.

- **Multistate outbreak of listeriosis.** Thirty-four hospitalizations and seven deaths were attributed to consumption of prepackaged caramel apples that had been packed under unsanitary conditions in California.

Example of the Cost of Food Safety Problems

Foodborne illness outbreaks can be very costly to the growers involved and often to growers who had nothing to do with the contamination. Take a look at these examples:

- **\$5 million** from *E. coli* on lettuce from the Salinas Valley, California, in 2003. In an out-of-court settlement, the company involved was ordered to pay out \$5 million to people who had eaten the lettuce.
- **\$100 million in sales** from *Salmonella* on tomatoes in 2008. Tomato growers lost an estimated \$100 million in sales, but then it was discovered that the source of the outbreak was actually jalapeno peppers in salsa.
- **\$100 million in sales** from *E. coli* on spinach from California in 2006. This severe outbreak essentially stopped all sales of spinach, even sales to processors. Total losses were estimated at \$100 million across the whole spinach industry.
- **Cancellation of all exports** due to *Cyclospora* on raspberries imported from Guatemala in 1996 and 1997. For some time, Guatemala could not export raspberries to the United States.

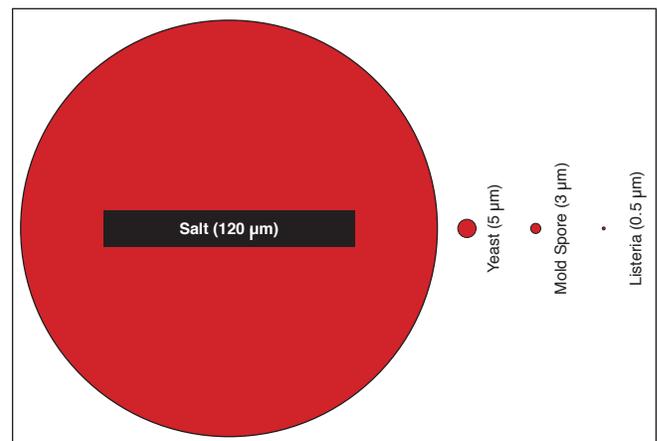
What Have We Learned from Outbreaks?

- Many people can get sick.
- Too many people die.
- Contaminated produce can come from the United States or other countries.

- Finding the source can be challenging.
- Blame can fall on uncontaminated fruits or vegetables.
- Outbreaks are expensive.

Produce Safety Challenges

- Many fruits and vegetables are consumed raw, with no cooking or “kill step” to destroy pathogens that may be on the produce.
- It is difficult to know contamination has occurred because events are sporadic and affect only small portions of the crop.
- Microorganisms are not easily seen, so contamination is difficult to detect visually.
- Many fruits and vegetables have rough surfaces, folded areas, and stem scars that provide places for pathogens to hide.



Size of Microorganisms

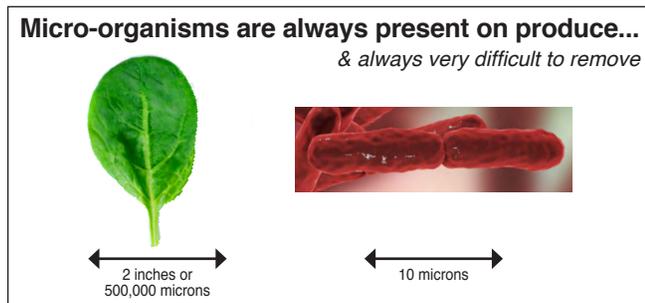
Just how small are microorganisms? To give you some context, we can compare microorganisms to a grain of salt. The diagram below is drawn to scale. The large red circle represents the size of a grain of salt. The three smaller circles represent the relative size of various types

of microorganism. After the grain of salt, the next largest is the yeast cell, which is very small (about 5 microns). Mold spores are tinier. The tiniest red dot represents a cell of *Listeria monocytogenes*, a human pathogen.

Compared to the salt grain, we can see just how tiny these microorganisms are. This shows how easily they may hide in crevices on the surface of fruits and vegetables and on farm and packing house equipment.

So, microorganisms are always present on produce, but difficult to remove from their cracks and crevices and other hiding places.

Consider a spinach leaf, which is about 50,000 microns (or 2 inches) long and has many breathing holes, or stomata, which allow carbon dioxide to enter and oxygen to exit the interior of the leaf. These holes are anywhere from 5 to 25 microns long. That's only a fraction of the width of a human hair. Very tiny bacteria (the gray rod shapes in the image below) can even hide inside leaf stomata, which help plants breathe.



Prevention Is the Key!

- The focus of produce safety is on preventing contamination from occurring.
- Once present, microbial contaminants are very difficult to remove.

What Can Be Done on the Farm? Use Good Agricultural Practices (GAPs)!

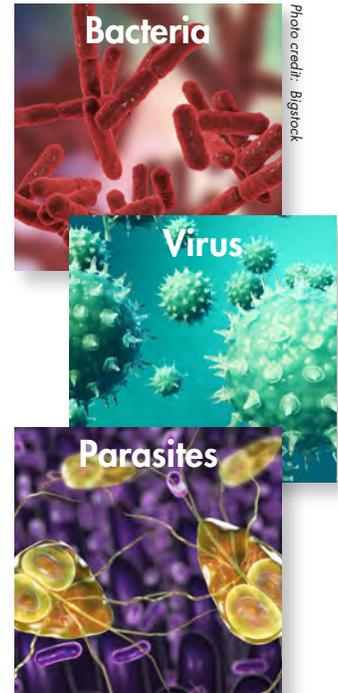
What Are Good Agricultural Practices?

Steps to prevent on-farm contamination of fruits and vegetables are known as Good

Agricultural Practices (GAPs). These are ways to prevent contamination of fresh produce from harmful microorganisms, such as:

- *Salmonella*
- Pathogenic *E. coli*
- *Listeria*
- Viruses
- Parasites

GAPs are just commonsense recommendations that protect the people who eat your food, and protect your farm business from the economic consequences of food contamination. Most likely you are already practicing recommended GAPs on your farm.



GAPs and Food Safety

Produce safety affects and is critical to every fruit and vegetable grower because food that consumers will eat is produced on their farms.

Growers are the key to produce safety on a farm. They are the major decision-makers for their farms because only they know their day-to-day activities—from production practices, to who works on the farm, and all of the other details involved in running a successful business. For this reason, growers need to be involved in assessing food safety risks and developing the farm's food safety plan. Making the decision to do something on the farm is up to the growers because they know their farms best.

Actions to reduce food safety risks impact not only the financial viability of farms but also the health and safety of those who

consume the produce grown. All farms, regardless of size, location, or commodities grown, can reduce food safety risks.

Contamination Sources

First, we must understand the potential sources of the microbes on the farm. The four main contamination sources are humans, animals, water, and soil amendments.



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- **Humans** can carry pathogens and spread them to produce, food-contact surfaces, or other people while they work on the farm. If they work when they're sick, lack training in proper handwashing techniques, and do not have access to adequate toilet facilities, workers can spread pathogens to produce when they handle fruits and vegetables. Contamination may also occur from an illness or injury that results in blood on produce.
- **Animals**, both domesticated (e.g., cattle, chickens, pigs, family pets) and wild (e.g., deer, geese, wild pigs), can carry and transmit human pathogens to produce in their feces, and spread contamination by tracking feces through the field as they move. Produce can also be contaminated directly or indirectly by feces through contamination of water or cross-contamination from movement of wildlife.
- **Water** is an excellent carrier of pathogens and can contaminate entire fields or large amounts of produce. Surface waters, such as rivers, ponds, and lakes, have a higher risk of carrying pathogens. Runoff and flooding may contaminate entire fields. Water must be of appropriate quality (microbial load) for its intended use. For

example, water used for spraying a crop close to harvest will need to have a lower concentration of microbes than water used to irrigate a crop that has just been planted.

- **Soil amendments**, especially raw manure or other biological components of animal origin that have not been treated or have been improperly treated to reduce microbial risks, are very high produce/food safety risks.

We will cover this very important topic in more detail in another section.

GAPs Recommendations

Since soil, water, hands, and surfaces are the primary sources of contamination, recommended Good Agricultural Practices can be boiled down to four basic points: clean soil, clean water, clean hands, and clean surfaces.

- **Clean soil:** take steps to reduce the possibility of transferring microbial contaminants from the soil to the crop.
- **Clean water:** make sure water used in different steps of crop production, harvest, and packing is not a source of contamination.
- **Clean hands:** applies to workers and their use of good personal hygiene in the field and packing house; be sure to provide clean facilities for workers and visitors.
- **Clean surfaces:** make sure that all packing lugs, bins, work surfaces, storage areas, equipment, and transportation vehicles are properly washed and sanitized on a regular basis.

What Can You Do to Prevent Contamination of Fresh Produce?

We know that contamination can occur at many different steps. Right now we will look at what is happening on the farm by going through the entire crop cycle. We'll start before planting begins, move through the growing season to harvesting, and finally end with postharvest handling.



Contamination can occur at every step of the production cycle; thus, it is important to look for food safety risks in every production step in a farm operation, and mitigate and prevent them before they can occur. We'll start before planting begins, move through the growing season to harvesting, and finally end with postharvest handling.

Contamination can occur:

- In the field
- During harvest and/or transportation
- During processing and packing
- During shipment and marketing
- In stores, restaurants, and supermarkets
- At home

Before Planting

We need to think about how to minimize the potential risks and contamination sources even before planting a crop. Find out if the field in which you are going to plant poses any risk by asking the following questions:

- How was the field used in the past?
- Were animals allowed to graze there?
- Was fresh manure applied to the field?
- Does the field flood frequently?
- Are there domestic animals near the field?
- Do wild animals travel through the field regularly?
- Is manure stored nearby?

Avoid planting on sites that regularly flood. When streams overflow onto fields,

microbial and chemical pollutants in the water can make the crop unsafe to eat. If a fresh produce crop contacts floodwater, there is no way to completely wash away dangerous microorganisms or toxic chemicals. The produce must be destroyed so no one can eat it.

During Crop Production

Crop production is an important time to monitor for situations that might contribute to contamination.

The water used for irrigation and spraying pesticides needs to be “clean.” As much as possible, we need to keep domestic animals (including pets) and even wild animals out of the field because their feces can contaminate the crop.

Any soil amendments we use should not be a source of microbial contaminants—for example, in order to maintain “clean soil,” we should not apply raw manure to a vegetable or fruit crop during the growing season.

In addition, we can use growing practices that protect the edible portion of the plant from coming into direct contact with the soil. Examples include staking tomatoes or using plastic mulch or straw mulch.

During Harvesting

Harvesting is an important time to use Good Agricultural Practices because our fruits and vegetables are getting closer to the customer’s plate. “Clean hands” and “clean surfaces” become important here.

A lot of hand contact with the crop occurs during harvesting. Workers who are handling the fresh produce must be healthy and follow good hygienic practices. We will talk in more detail about this later, but this means that workers need access to clean, working toilets and handwashing facilities, and that they use both correctly! It also means that the tools used to harvest, and the bins used to hold the harvested produce, need to be clean.



Postharvest: Handling Produce

Postharvest practices involve transporting, sorting, washing, and storing the crop. This is an extremely important time to use Good Agricultural Practices because our fruits and vegetables are very close to the customer's plate!

"Clean hands," "clean water," and "clean surfaces" are critical here. As with harvesting, we want to make sure that workers are healthy and trained to use proper hygiene.

We also want to make sure that any surface—for example, boxes, grading tables, knives, vehicles, and, of course, hands—that comes into contact with fresh produce is clean, we are only using clean (potable) water for washing and cooling, and we are making sure that there aren't any pests like rodents or birds around.

GAPs: Part of the Solution

Good Agricultural Practices do not exist by themselves; they are part of a larger picture of efforts to ensure that our food is safe to eat, and to verify that farms are implementing GAPs appropriately. Three forces are at play currently in the area of farm food safety: buyer requirements, regulatory requirements, and moral/ethical standards (i.e., doing the right thing for people eating the food you grow).

Buyer Requirements

With the increased focus on Good Agricultural Practices to verify that farms are producing fruits and vegetables in the safest way possible, the

retail and food service industries are using third-party GAP audits to verify that their suppliers are complying with specific agricultural practices. GAP audits based on globally accepted farm food safety principles and practices are available through the USDA and private audit programs.

Wholesale and retail buyers of fresh produce want to limit their businesses' risk of being part of a foodborne illness outbreak. They want to protect their name or brand, and they don't want to lose money because of an outbreak. So, it has become very common for wholesale buyers to require the farms they buy from to follow GAPs.

Regulatory Requirements

The Food Safety Modernization Act (FSMA) was signed into law on January 4, 2011, and is the most sweeping reform of the food safety laws in United States in over 70 years. One of the regulations under FSMA, the Produce Safety Rule, contains standards for growing, harvesting, packing, and holding fresh produce that is intended or likely to be eaten uncooked. Good Agricultural Practices are woven tightly into the Produce Safety Rule. So, there is a tight link between GAPs and FSMA's Produce Safety Rule.

Farms with less than \$25,000 in produce sales (2011 dollars) are not covered under the rule. Other small farms, though covered under the rule, are exempted from complying with the whole of the Produce Safety Rule depending on gross sales and where and to whom their fresh produce is sold. Farms required to comply with the Produce Safety Rule, in full or in part, are subject to regulatory inspections to verify their compliance.

Resources

For GAPS-related information from Penn State Extension, such as upcoming workshops, training, and publications, go to extension.psu.edu/food-safety-and-quality/farm-food-safety.

WORKER HEALTH AND HYGIENE

Worker health and hygiene is the most important part of a food safety program, but it is often the most difficult to implement, which is why it is so important to train workers in farm food safety practices. Food safety practices are learned, so regular training is the key to its successful implementation. Workers are a critical part of any farm food safety plan because they are responsible for using food safety practices every day while they work.

Pathogens of Concern

Workers can carry human pathogens (microscopic organisms that can cause illness) such as:

- **Shigella.** This bacteria causes dysentery (persistent diarrhea and loss of body fluids). In some cases, acute kidney failure and death occur. It is contracted orally by direct contact of feces with food. Transmission may occur by hands that became contaminated by feces, in particular after using the bathroom without being properly washed.
- **Salmonella.** This type of bacteria is found in feces and soil and survives for up to nine months in water. It is transmitted by eating fruits, vegetables, or water contaminated with feces from an infected animal or person.
- **Hepatitis A.** This very contagious virus causes liver inflammation, diarrhea with stomach pains, jaundice (sudden yellowing of skin and eyes), dark urine, fever with headache, and nausea. People infected with Hepatitis A suffer one or more recurrences from nine to 12 months after contracting the disease. It lasts approximately three weeks in each recurrence. Infected people contract secondary infections more readily, and these last longer than usual.

- **Norovirus.** *Norovirus* is often associated with cruise ships where crowded conditions cause the virus to spread rapidly. People become infected by eating food or drinking liquids contaminated with *Norovirus*, touching contaminated surfaces or objects and then touching their mouths, or from direct contact with an infected person. This is called the fecal–oral contamination route and causes sudden onset of diarrhea, vomiting, nausea, and abdominal cramps.

Sources of Contamination

Feces can contaminate produce directly if workers defecate in the field or if there is a leak in the sewage system.

Workers' hands can also be a source of contamination if they do not wash them properly with soap and water after going to the bathroom or returning from a break (e.g., after eating/snacking or smoking) and then handling produce. The fecal–oral route is the most common way for produce to become contaminated.

Cross-contamination occurs when bacteria or pathogens are carried from one object to another. It can happen in many different ways, including from:

- **Clothing.** Dirty clothing can carry pathogens from one place to another (e.g., from dirty clothes to vegetables or fruit when picking).
- **Footwear.** Indirect contamination can occur when footwear contacts human or animal feces and then



transfers to produce or food-contact surfaces. When working with animals or handling manure, workers need to use proper



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footwear and protective outer garments (e.g., aprons or coveralls) to protect their shoes and clothing from contamination.

- **Tools/equipment.** If proper hygiene practices are not followed, workers can contaminate tools/equipment. In turn, contaminated tools/equipment may transfer pathogens to produce. Lack of or inadequate handwashing, and unwashed or unsanitized tools/equipment may result in cross-contamination of fresh produce.



Photo credit: Bigstock

- **Cuts, open sores, and boils.** These can result in blood or other bodily fluids contaminating produce, which is one reason why stressing worker safety on the farm is so important. Workers should immediately report any cuts they have to a supervisor to prevent blood contamination of produce. Workers with open sores and boils should be prevented



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from working directly with produce.

- **Contact with saliva and mucus.** Pathogens can be spread through saliva and mucus, and contact with other contaminated surfaces. For example, hands may become contaminated while eating, smoking, coughing, or sneezing.
 - **Coughing** scatters saliva particles travel up to 11 feet.
 - **Sneezing** scatters 5,000 droplets across a room.
 - **Spitting** forcibly ejects saliva or other substances from the mouth.
 - **Touching the mouth** brings saliva to the hands and everywhere hands touch.

Coughs and sneezes stay airborne for long distances and float farther than one may think! One sneeze can scatter invisible droplets as far as 17 feet. Sneezing onto hands, handkerchiefs, or tissues only partially contains the droplets but results in contaminated hands. The best way to sneeze is into your elbow. The impact is more localized and droplets are not projected as far. Spitting also spreads particles because saliva travels through the air, contaminating everything on its path to the floor.



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Training employees about when and how to properly wash their hands is of utmost importance. Workers must wash their hands when they are contaminated by any of the abovementioned actions. Worker training should include how to wash hands properly, and provide the chance to practice this skill during the session.

Prevention and Best Practices

For growers, farm workers, packers, and shippers, prevention is the key to controlling potential microbial hazards and sources of contamination. Preventing problems before they become critical contamination hazards is of utmost importance in any fresh fruit or produce operation. Studies have shown that once contamination occurs, it is very difficult to remove all pathogens.

Worker Training

Grower commitment is the key to training success!

- Train all newly hired workers to follow good hygienic practices.
- All workers and employees should have a good working knowledge of basic sanitation and hygiene principles.
- Each producer should develop a sanitation training program for their workers and employees.
- Depending on the workers' job requirements, periodic refresher or follow-up training sessions may be needed.
- For part-time and seasonal field workers, the grower or the supervisor should verbally instruct and demonstrate proper health and hygiene practices.
- Document the training in the training log.

Make sure all newly hired workers are trained and have a good working knowledge of basic sanitation and hygiene principles. Depending on the situation, formal presentations, one-on-one instruction, or demonstrations (e.g., on the proper use of hair nets and face masks when packing and sorting) may be selected. In the field, training on the proper use of toilet facilities may be appropriate.

When formalized training programs are not practical, informal trainings and demonstrations should always be done for these personnel.



The grower or supervisor should verbally instruct and demonstrate proper health and hygiene practices, such as proper handwashing techniques or using a toilet facility properly. Always document (keep a record of) all trainings and steps taken to enforce compliance with local, state, and federal hygiene standards.

Training should include:

- Maintenance of personal cleanliness
- Avoiding contact with animals (other than working animals)
- Removing or covering rings that cannot be cleaned
- No eating, chewing gum, or using tobacco in an area used for packing produce or while working in the fields
- Recognizing signs of illness and notifying the supervisor when ill
- How and when to wash hands properly
- Maintaining gloves in sanitary condition

Visitors

Visitors include people (other than hired workers) who enter the farm with permission (e.g., “pick-your-own” customers, agricultural tour groups, and school groups). Visitors should be trained in or at least informed of the basic sanitation and hygienic principles of the farm. They must be made aware of food safety policies set by the farm and have access to toilet and handwashing facilities. Policies can be reviewed with visitors through

posters, handouts, short policy summaries, or verbally when they enter the farm. Key items to review with volunteers and visitors include:

- Parts of the farm and packing areas they can enter
- Not visiting the farm if they are sick or have symptoms of illness
- Why, when, where, and how to wash their hands
- Not bringing pets to the farm

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Overall Cleanliness

Good personal hygiene begins at home. Being clean and in good health when at work shows that workers care about the health of others. Workers should follow these habits at home, before going to work:

- Bathe or shower every day
- Keep hair clean and trimmed
- Keep nails short

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Healthy Conditions

Employees who have illnesses that can spread through food should not work directly with fresh produce. Workers should not handle food products if they have:

- Diarrhea
- Fever
- Vomiting
- Jaundice (yellowing of eyes or skin)
- Sore throat accompanied by fever

Open wounds, sores, and infections are potential sources of dangerous bacteria that cause disease, such as Staphylococcus. These bacteria can be transferred to food and cause serious illness. All cuts and swelling in workers' hands should be treated as if they were infected, by covering them with a bandage and then wearing disposable gloves.

Keeping food safe requires good communication between workers and their supervisor. It is critical that workers report symptoms and conditions of illness to their supervisor as soon as they become aware of them. Workers who could be sick may be asked to do work that is unrelated to food handling.

Sometimes people who handle food carry a disease-causing pathogen but still appear healthy. In these cases, these microorganisms may be present in the feces and saliva of the person long before symptoms are seen. For this reason, it is important that workers let their supervisor know if they have been exposed to people with infectious diseases, even if they are not sick.

Adequate first-aid materials must always be available at farm headquarters and on buses or vehicles used for transporting workers. Keep in mind the number of workers/employees you have, and keep ample materials to meet their needs (bandages, band-aids, alcohol, etc.).

Clothing, Jewelry, and Personal Items

Don't let clothing or other personal items become a source of contamination. Worker clothing and equipment are important because dirty clothes, shoes, and gloves can lead to cross-contamination of produce.

If working in packing houses, workers should bathe daily and go to work in clean clothes. Depending on the policies of the farm operation, workers

having direct contact with produce may need to wear protective clothing such as disposable gloves, masks, aprons, or uniforms.

Gowns and aprons that have fallen on the floor should be considered contaminated. They need to be cleaned and disinfected before being reused. Torn work clothes need to be replaced immediately. When leaving a work area for a break or to use the restroom, workers should hang their protective clothing in the area assigned to them. At the end of the shift, workers should leave their work clothes in the area designated by their supervisor. If protective clothing is taken home for cleaning, wash them separately with water that is as hot as possible and then dry them outdoors.

Jewelry worn by workers may fall into produce, which presents a physical food safety hazard. Jewelry may also become stuck in processing equipment or farm tools,



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making them a serious safety risk to workers. Each day before beginning work, remove jewelry and other objects from the hands and face, and store them in the area assigned for storage. Jewelry that cannot be removed should be covered by gloves to prevent contamination.

Don't bring personal items into the work area that can fall into exposed food or onto work areas. Coins, paper clips, rubber bands, cigarettes, and even buttons on clothes can fall into food and perhaps cause someone to choke or cause injury. Items such as pens, pencils, and thermometers may be needed for work. Bring these items to the work area only if approved by a supervisor and adequately protected.

Eating, Drinking, and Tobacco Use

Don't eat, drink, spit, chew gum, or use tobacco in work areas. Eating, drinking, chewing gum, and using tobacco can transfer saliva to hands which can, in turn, contaminate food. Use dining rooms, rest areas, and designated smoking areas for these activities. Always wash hands afterward.

Employees and visitors should never eat or taste food products directly from the packing line or storage areas. Be aware of these behaviors and how they can affect food safety.



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Toilets

Inadequate toilet use is a major food safety risk that happens more often than you think. Certain practices may create greater contamination risks, such as toilet paper being placed in a garbage can or on the floor next to the toilet.

Toilet availability is very important, as workers without these facilities will eventually defecate or urinate directly in or at the edge of fields, where runoff can be a source of contamination.

Occupational Safety and Health Administration (OSHA) regulations require that one handwashing station per 20 workers be available. They must be located within $\frac{1}{4}$ mile or a five-minute walk or drive from the field or workplace. Handwashing stations need to be kept clean and sanitary. They must have clean, running water; hand soap; and single-use, disposable hand towels. Shared towels of any kind are unacceptable—they become an easy path to spread contamination. A trash container for soiled hand towels should be placed nearby. Even if there is just one worker, toilets and handwashing stations must always be available. Some farms using portable toilets prefer to rent or buy portable facilities where the sink is located right outside the structure. This facilitates easier monitoring of handwashing after toilet use.

Proper handwashing lowers the risk of feces contaminating produce and other people. It is imperative to let all workers know that they must wash their hands with soap and water after going to the bathroom. Additional training may be necessary so workers understand that toilet paper should be thrown into the toilet, not dropped on the floor or placed in a garbage can. Also, urinating (peeing) and defecating (pooping) should be done in the toilet, never in the field.

How to use toilets correctly:

- Train workers, especially temps, on how to use toilets properly.
- Do not throw toilet paper on the floor.
- Do not throw toilet paper in the trash.
- Place used toilet paper in the toilet
- Wash your hands after using the toilet.
- Do not dry your hands on your clothing. Use a disposable towel.

All toilets and handwashing stations should be cleaned on a regular and scheduled basis. Toilets should be monitored daily to ensure they are cleaned according to a regular schedule, remain well stocked, and are always in working condition. Workers should be instructed to tell their supervisors if there is a problem so that it can be fixed. Posters in a language that all workers can read and understand should be placed in visible areas to indicate where toilets and sinks are located.

If your facility is small and a bathroom inside the home is used by workers, these same toilet and handwashing requirements apply. Document your policy on maintenance of handwashing facilities, including sanitation procedures for rinsing and cleaning wash-water tanks, frequency of water level checks, and availability of potable water, soap, and single-use towels.



Handwashing and Handwashing Stations

Past outbreaks of foodborne illnesses have usually been associated with produce becoming contaminated with fecal material due to improperly washed hands. Washing hands after using the toilet is most important; however, it is not the only time hands must be washed. Hands should be washed as frequently as possible when hand-picking, sorting, or packing produce.

Handwashing should be done after taking breaks, eating or snacking, and smoking. This information should be part of worker training.

Hands must be washed:

- Before starting and returning to work
- After using the toilet
- After working with pesticides
- Before and after eating or smoking
- After touching or working with animals or animal waste
- Before putting gloves on
- Anytime hands can become contaminated, such as when you touch your face, hair, etc.



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Workers must wash their hands thoroughly by scrubbing with soap (or other surfactants) and running water that meets water quality requirements. Hands must be

dried thoroughly using disposable paper or sanitary towels, electric hand dryers, or other adequate hand-drying devices. Never allow shared use of towels.

The key to good handwashing is both friction and the duration of that friction. “Clean” implies there is a physical removal of visible filth with soap and water of adequate sanitary quality. When washing hands, scrub between the fingers and under fingernails.

Also scrub the wrists. Proper handwashing takes 20 seconds of scrubbing with soap. Water temperature is not as critical as the use of soap and vigorously rubbing hands. Warm water is more comfortable for workers, but it is not essential; cold water works just as well.

Teach workers to wash their hands for at least 20 seconds. This can be measured by singing “Happy Birthday” or the “Alphabet” song twice in English, or another song that lasts approximately the same length. Ideally, someone on the farm should watch workers wash their hands with soap and water every time they use the toilet. Sometimes, a large number of individuals who use the toilet do not even rinse their hands and continue handling produce for the rest of the day. This creates a potential source of contamination that growers need to watch for to at least minimize the risk of fruit contamination.

Six Steps for Handwashing

1. Wet hands with clean, potable water.
2. Apply soap and lather.
3. Scrub hands between fingers and under fingernails for at least 20 seconds. Using a nail brush is even better.
4. Rinse soap off thoroughly.
5. Dry hands with single-use paper towels.
6. Discard used towel in a covered trash can.

Note: Antibacterial hand sanitizers **cannot** replace soap and water for handwashing.



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Hand sanitizers can be used in addition to handwashing, but never as a replacement for soap and water. Sanitizers do not work effectively if hands have dirt or are very soiled, which is common on farms.

Remind workers daily of the importance of handwashing. Place signs in a language that all workers can read and understand in visible, appropriate places to remind them of proper handwashing techniques and that water is for “handwashing use only.”

Gloves

Transitory microbes are on the skin surface and are easy to wash off, while resident microbes get deeper in the skin and are harder to wash off. Single-use, disposable gloves provide an additional level of protection against resident microbes and the transfer of microorganisms from hands to food. If used properly, gloves provide a sterile



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food-contact surface. However, there are some potential problems when using gloves. Knowing when to use gloves is important to prevent contamination of food.

Wear gloves when:

- Handling cooked or ready-to-eat products
- Using a bandage to cover a minor wound or sore on hands
- Wearing hand jewelry that cannot be removed

Gloves are only effective if used correctly. Improperly worn gloves can jeopardize food safety! To be effective, gloves should:

- Fit properly so they are less likely to become damaged while working
- Only be worn after hands are properly washed and sanitized
- Not be used to handle raw materials or contaminated surfaces

Change gloves as often as necessary to keep food safe! Gloves should be changed whenever they may become a source of contamination. Workers should put on a new pair of gloves:

- At least every four hours when in continuous use, and more frequently when handling ready-to-eat foods
- Anytime they are torn or punctured
- Anytime that workers would otherwise need to wash their hands, such as when returning to a workstation or after touching an unclean surface

Foot Traffic

Foot traffic is another potential produce safety hazard. Shoes carry pathogens that can be transmitted to produce. Train workers to understand that they should not walk into contaminated areas (unless authorized), and

to follow policies on changing shoes when needed. Designate boots for activities that involve animals, such as mucking stalls or feeding animals. Do not wear dirty boots, especially those covered with manure or other contaminants, in produce fields or packing areas. If workers have been in animal manure storage areas or places where pesticides are prepared or sprayed, make sure they have been trained to wash their hands and change their outer clothes and shoes before handling fresh produce.

Drinking Water

Workers must always have access to drinking water when working in the field. Provide drinking water dispensed in single-use cups or by fountains in a nearby break area for workers in the field. Do not use regular drinking cups or dippers.

To avoid person-to-person contamination, drinking cups should not be shared. Sharing or using personal cups is not permitted in the packing area for the same reason. It is better to have single-use cups rather than personal cups or glasses.

If workers are allowed to bring their own water containers, make sure the containers are unbreakable plastic or metal, and that workers know where to refill them. Glass cups or bottles may break and create a physical hazard, so they should not be used, although glass-lined metal thermos containers are permissible. Bottled water in the field is acceptable if bottles are plastic and can be capped to prevent spills. Empty plastic bottles

must be thrown into the garbage, not dropped in the field or in irrigation ditches.

Personal Hygiene in the Field and in the Packing House

Hands should be washed as frequently as possible when hand-picking, sorting, or packing produce or fruit. Handwashing should be done after taking breaks, eating or snacking, and smoking. This information should be part of worker training.

The FSMA Produce Safety Rule requires farms to have a designated area near or at the edge of the fields where workers can go to drink water, have lunch, or take breaks. A suggestion is to have a tent or a shaded place with picnic tables and waste containers with lids where workers can meet one another to eat. There should be no eating, chewing gum, or using tobacco products while working in the field.

If working in packing houses, workers should bathe daily and come to work in clean clothes. Personnel who have direct contact with produce may need to wear disposable gloves and other protective clothing. The designated eating area should be clean and separate from packing areas. Provide covered trash cans in designated break areas. Untrained workers may throw food or wrappers on the floor, and these can become a source of contamination. Waste bins should be emptied regularly.



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Recordkeeping and Monitoring

Recordkeeping is critical to monitoring because it allows actions to be documented to ensure they are done properly and on time. Do not make recordkeeping more difficult than it needs to be. Keep recordkeeping logs with pens attached in an easy-to-reach place, near where activities being monitored occur. Records or logs should be created at the time an activity is performed or observed.

Developing a monitoring program may include assigning individuals to do specific tasks on the farm, such as checking to make sure the bathrooms are clean and well stocked, observing employee behavior for signs of sickness, monitoring handwashing after bathroom use, and checking for proper protective clothing.

Most growers rent portable toilets from business firms that also clean both the toilets and the handwashing facilities on a schedule. However, for safety reasons, a person on the farm should be appointed to make sure those facilities are truly clean, well stocked, and in working condition.

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Corrective Actions

Workers need to be aware that not following food safety practices is unacceptable.

The farm food safety plan can designate actions to address

workers not

following company policies, such as being sent home for failure to wash their hands.

Farm food safety plans should include a written emergency plan (corrective steps) for spills in portable toilets. The proactive plan should have names of who to call and what to do in case of an emergency. Training workers helps them learn what to do in emergency cases. In cases where corrective actions are needed, workers should be retrained to improve the monitoring process.

Corrective actions should be considered if monitoring identifies a problem, such as:

- Workers not following food safety policies
- An evident food safety risk
- Facilities that are not clean, restocked, or in working order
- Facilities that leak in the field or packing house



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PREVENTING CONTAMINATION BEFORE, DURING, AND AFTER HARVEST

Prevent contamination before, during, and after harvest to:

- Protect yourself and your customers from injury and illness
- Assess risks before produce leaves the farm
- Protect the financial viability of your farm

Workers are critically important in preventing contamination in the field, during harvest, and in the packing shed. Workers are on the “front lines” as the ones most closely and most frequently involved in viewing, selecting, harvesting, and handling produce. It is very important that workers be trained and empowered to recognize, respond, and confidently report to their supervisors any conditions in the field and in the packing house that may potentially contaminate produce. And of course, workers should not be a source of contamination themselves.

TYPES OF RISKS

Microbial Risks

Pathogenic organisms such as *E. coli*, *Salmonella*, Hepatitis A, and *Norovirus* can be spread to fresh produce through animal waste (feces), human waste, infected workers, and contaminated water or food-contact surfaces.

Sources of microbial contaminants are numerous. Feces (poop) can contaminate produce directly if workers defecate (poop) in the field or there is a leak in the sewage system. Animal waste left in fields is another potential source of contamination. Hands can cross-contaminate produce if workers do not wash their hands properly with soap and water after going to the bathroom or returning

from a break.

Workers who are infected with some pathogens can contaminate fresh produce by sneezing, coughing, or touching their nose or mouth. Cuts, open sores, and boils can result in blood or other bodily fluids contaminating produce. Cross-contamination can occur when fresh produce comes in contact with contaminated water, food-contact surfaces, tools, hands, clothing, or other sources.



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Nonmicrobial Risks

The Produce Safety Rule focuses primarily on reducing microbial food safety risks; however, two other types of food safety risks exist: chemical food safety risks and physical food safety risks.

Chemical hazards include pesticides, detergents, sanitizers, and other chemicals used on the farm. Chemical food safety risks can come from the improper application of pesticides or other chemicals, such as detergents and sanitizers, that are used on or near produce. Be sure to keep chemicals and cleaning supplies in a locked storage cabinet or separate shed away from fresh produce handling areas.

Physical hazards include wood, metal, glass, plastic, or other foreign objects that can end up in



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the produce. Physical food safety risks can be present if any foreign material comes in contact with produce or produce-handling equipment. For example, broken glass from light fixtures is a physical hazard, especially in the packing and storage areas.

Before Harvest

Preharvest Best Practices

- Worker training and hygiene
- Clean and sanitized food-contact surfaces, containers, and transportation
- Proper use of toilets and handwashing stations
- Designated break areas in fields and packing sheds
- Water is of appropriate quality (microbial load) for its intended purpose (drinking, cleaning, irrigation, applying pesticides, frost protection)
- Adequately maintained tools and machinery
- Proper management of manures and compost
- Proper storage of chemicals (sealed and labeled containers in a locked cabinet)

Worker Training and Hygiene

Workers are key to ensuring harvest and postharvest activities are done properly, thus the importance of training. Workers are a critical part of any farm food safety plan because they are responsible for using food safety practices every day while they work. Worker health and hygiene is the most important part of a food safety program but often the most difficult to implement—thus the importance of worker training in produce/food safety practices. Food safety practices are learned, so training is the key to its successful implementation.

Worker training should include:

- Maintenance of personal cleanliness
- Avoiding contact with animals (other than working animals)

- Removing or covering hand jewelry that cannot be cleaned
- Not eating, chewing gum, or using tobacco in packing areas or while working in the fields
- Recognizing signs of illness and notifying their supervisor if they are ill
- How and when to wash their hands properly
- Maintaining gloves in sanitary condition, if used

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Washing and Sanitizing

Washing removes visible dirt, soil, dust, and contamination from a surface, while sanitizing reduces, but does not kill, the number of harmful bacteria, viruses, and fungi (i.e., it makes a surface free of visible dirt contaminants that could affect your health).

Remember: You cannot sanitize without first washing a surface. This is because too much organic matter decreases the effectiveness of a sanitizer.

Steps for properly cleaning and sanitizing food-contact surfaces, equipment, and utensils:

1. Rinse the surface to remove any obvious dirt and debris.
2. Apply an appropriate detergent and scrub the surface.
3. Rinse the surface with water that is the microbial equivalent of drinking water (potable).
4. Apply an appropriate sanitizer (if the

sanitizer requires a final rinse, this will require an extra step) and let the surface air-dry without wiping.

Preharvest Assessment

- Wash, scrub, rinse, and sanitize all containers prior to use and discard damaged containers.
- Separate tools used for handling manure and tools for harvest.
- Tools should be cleaned on a scheduled basis.
- Store and cover packing materials in a covered location.
- Do not stand or sit in harvest bins or containers.
- Remove dirt and debris from containers before stacking.
- Do not stand or sit in harvest bins or containers.
- Do not stack directly on soil or floor.
- Monitor fields to be harvested for signs of animal intrusion.
- Check equipment and machinery for maintenance needs. Make sure equipment does not pose a risk from leaking hoses, breaking glass, or broken parts.



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During Harvest

Best Practices for Harvesting

- Practice worker hygiene in the field: clean clothes; covered shoes; no eating, drinking, or smoking while working; and wash hands.
- Pick fruits and vegetables when they are dry to minimize the amount of soil adhering to the harvested produce, especially in the case of field-packed produce.
- Never harvest produce that is damaged or rotten.
- Never harvest produce that falls to the ground.
- Remove harvested produce from field

as soon as possible (do not leave fresh produce in the sun or under a tree).

- Exclude domestic animals and wildlife from fields.
- Minimize habitat, nesting, and hiding places for rodents and other vermin in and around the fields.
- Keep “boneyards” and debris piles away from fields.
- Inspect unused buildings for pest and wildlife nesting.
- Workers must be trained to never harvest produce that has come in contact with animal droppings.

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Reduce Risks in All Packing Areas

- Keep it clean. Sweep, pick up trash, remove cull piles—good housekeeping goes a long way!
- Separate produce handling areas from other farm activities such as vehicle repair, spray mixing, and storage.
- Provide proper hygiene facilities for workers. Toilets, handwashing facilities, and separate eating and break areas are key for making sure workers do not contaminate fresh produce.
- Avoid standing water and condensate. Whether in a closed operation or an open packing area, try to reduce standing water in equipment and on the floor (or ground). Standing water can support the growth

and persistence of pathogens such as *Listeria monocytogenes* and splash onto fruits, vegetables, and equipment, in turn spreading contaminants throughout the packing area.

- All packing areas should have a pest management program. Closed operations have more ability to exclude rodents and other pests, but pests can still be managed in open operations.
- Keep it organized. Having a cleaning process and place for tools and equipment can help ensure they are in good working condition and clean for the next use. Having a system minimizes confusion, increases efficiency, and helps reduce risks by making sure important cleaning and sanitation steps are done properly each day.

Packing Sheds

Not all packing sheds have four walls; many are open on at least one side. Although an enclosed packing area is preferred, open walls are acceptable if measures are taken to keep pests out and the area is kept clean and uncluttered.

Sheds where produce will be taken or stored should be cleaned, and floors washed and sanitized when possible, before taking produce inside. If a shed has glass fixtures, they should be shatterproof or covered. Check inside and outside the building; repair holes, leaks, and cracked walls and floors; and remove standing water. Weed and mow grass outside the perimeter of the building to avoid nesting sites for rodents, moles, and other vermin.

Pest Management

It may be difficult to keep packing shed buildings extremely tight, but consider this: mice need only a quarter-inch hole to get into a building, and rats only need a half inch. As much as is practically possible, refit doors

or use rubber stripping to seal up cracks and holes. The fewer ways that pests can gain entry, the better.

- Inspect storage and packing facilities weekly for rodents, birds, and insects.
- Use pest control procedures (traps, screening, and doors).
- Only spring-loaded or sticky traps to be used inside packing shed.
- Bait traps may be used outside.
- Apply chicken wire or netting on air intake and exhaust to prevent birds.
- Document the pest management plan and service reports.



After Harvest

Best Practices for Postharvest

- Use only water of sufficient quality (no detectable *E. coli*) for cooling, washing, or transporting produce.
- Make sure nothing can fall onto or into food.
- Keep food-contact surfaces clean, including harvest and storage bins, workers' hands, conveyors, belts, brushes, rollers, sorting tables, racks, and utensils.
- Sanitize food-contact surfaces on a scheduled basis.
- Make sure cold rooms are functioning properly, as temperature fluctuations can result in bacterial growth and food spoilage.

Water and Ice

Water is good at spreading pathogens, and too much water encourages spoilage and mold growth. Water for rinsing, washing, cooling, waxing, icing, or moving produce should meet the water quality standard of no detectable *E. coli* (per 100 mL).

Transport and store ice in covered plastic or plastic-lined bins. Use a dedicated shovel made of noncorrosive material, and clean and sanitize the shovel and bins on a scheduled basis.

To ensure the safety of postharvest water:

1. Always use water that meets the water quality standard of no detectable *E. coli* (per 100 mL).
2. Use sanitizers as needed with postharvest water.
3. Change bulk/batch tank water when dirty.
4. Make sure water is at the appropriate temperature to avoid infiltration.
5. Clean and sanitize tanks/bins daily, making sure to reduce or eliminate pooled water.
6. Document all postharvest activities.

Transportation

Some farms may use vehicles for many farming purposes and personal use. Such vehicles must be cleaned before hauling produce. As mitigation, a clean liner may be used as a barrier if adequate to prevent contamination.

- The vehicle that transports produce should only be used to transport produce.
- If the vehicle is used for transporting anything other than produce (e.g., live animals or compost), it should be cleaned and sanitized before being used to haul produce.
- Vehicles should be inspected before loading to make sure they are clean and free from debris and bad odors.
- If hiring transportation, make sure cleaning, sanitizing, and documentation are included in your contract requirements.
- Stipulate in the contract the recordkeeping logs they need to fill out and maintain.
- If refrigeration is required, make sure the cooling unit is functioning properly before

loading and that all door seals, air chutes, and side walls are in good condition.



Corrective Actions

If a food safety risk is identified in the produce packing, storage, or transportation vehicles:

- Immediately assess the situation.
- Has produce been affected?
- Can it still be sold, or does it need to be thrown away?
- Determine the cause of the problem.
- What needs to be done to correct it?
- Put corrective actions in place, keep records, and monitor to make sure the corrective actions have fixed the problem.



Corrective action should be taken and documented if food safety risks are identified in the packing, washing, storage, or transportation of produce. Think about both short-term and long-term solutions. How can the situation be fixed immediately? How can the event be prevented from occurring again in the future? Corrective actions can help fix a problem, determine its cause, and modify practices to make sure it does not happen in the future.

Corrective actions are needed when:

- Pest infestation occurs
- The packing line is contaminated by blood (cut finger on a sharp metal edge, etc.)

- A drain backs up into the produce handling area
- Other situations posing immediate risk of produce becoming contaminated occur

SUMMARY

- Prevent contamination to protect yourself and your customers from injury and illnesses.
- Risks can be microbial, chemical, and physical.
- All workers should be trained on health and hygiene to minimize potential food contamination.
- Cleaning and sanitizing are not the same thing. You cannot sanitize a dirty surface!
- Food safety practices (cleaning, general maintenance and housekeeping, and pest control) need to be in place to reduce risks.

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Resources

Penn State Extension:

extension.psu.edu/food-safety-and-processing

Produce Safety Alliance:

producesafetyalliance.cornell.edu

Centers for Disease Control:

www.cdc.gov/foodsafety

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