

Minimize Pathogen Contamination During Production and Harvest of Fresh Produce

Pre-Plant

Select Produce Fields Carefully

- ✓ Review land history for prior use and applications of sludge or animal manure.
- ✓ Choose fields upstream from animal housings.
- ✓ Know upstream uses of surface water and test water quality as needed.
- ✓ Prevent runoff or drift from animal operations from entering produce fields.

Store Manure

- ✓ Store slurry in continuously loaded systems for 60 days in summer or 90 days in winter prior to field application.
- ✓ Consider satellite storage for slurry used on produce fields.
- ✓ Compost manure properly to kill pathogens.

Time Applications and Incorporate Manure

- ✓ In fall- apply manure to all planned vegetable ground, preferably when soils are warm (>50°F), non-saturated, and cover cropped.
- ✓ In spring- incorporate manure two weeks prior to planting.
- ✓ Whenever possible, incorporate manure.
- ✓ Do *NOT* harvest produce within 120 days after manure application.
- ✓ Keep records of application rates, source, and dates.

Choose Crops Carefully

- ✓ Avoid root / leafy crops if manure is applied in spring.
- ✓ Plant agronomic or perennials crops where manure is applied in spring.

Production

Do NOT Sidedress with Manure

- ✓ *ABSOLUTELY DO NOT SIDEDRESS* with fresh or slurry manure or manure 'tea' or mulches containing fresh manure.
- ✓ OK to sidedress with mature composts or compost teas.

Exclude Animals

- ✓ *NO* grazing of livestock near produce fields.
- ✓ Minimize wild and domestic animal traffic in produce fields.

Promote Worker Hygiene in the Field

- ✓ Provide and maintain clean restrooms.
- ✓ Supply soap, clean water and single-use towels for hand washing and enforce use.

Test Irrigation Water Quality

- ✓ Identify water source for irrigation.
 - ◆ Municipal drinking water- low risk
 - ◆ Potable well water- minimal risk if well casing is maintained and livestock excluded from active recharge area
 - ◆ Surface water- high risk
- ✓ Test quarterly or during season (beginning, mid or high draw, and at harvest) if water source passes near livestock or sewage treatment.
- ✓ Filter or use settling ponds to improve water quality.
- ✓ Use potable water for crop protection sprays.
- ✓ Maintain records of water tests.

Select Irrigation Method

- ✓ Where feasible, use drip irrigation to reduce crop wetting and minimize risk.
- ✓ Apply overhead irrigation early in the day so leaves dry quickly.

Harvest

Clean Harvest Aids

- ✓ Check that bins are clean and in good repair.
- ✓ High-pressure wash and sanitize bins prior to harvest and clean bins daily during harvest.
- ✓ Remove excess soil from bins in field.
- ✓ Ensure that packing containers are not overfilled and protect produce adequately from bruising and damage.

Handle Produce Carefully During Harvest

- ✓ Avoid standing in bins during harvest to reduce pathogen spread by shoes.
- ✓ Minimize bruising of produce during harvest.
- ✓ Remove excess soil from produce in the field.

Promote Cleanliness at U-Pick

- ✓ Invite customers to wash their hands prior to entering fields.
- ✓ Provide clean and convenient restrooms.
- ✓ Supply soap, clean water, and single-use towels and encourage use.

Avoid Drops for Apple Cider

- ✓ Do not use decayed or wormy fruit.
- ✓ Pasteurize cider.

Promote Worker Hygiene (see "Production")

Keep Produce Cool

- ✓ Cool produce quickly to minimize growth of any potential pathogens.
- ✓ Use ice made from potable water.
- ✓ Store produce at appropriate temperatures to maintain good quality.
- ✓ Do not overload coolers.

Post-Harvest Handling

Promote Worker Hygiene and Health

- ✓ Teach workers about microbial risks and the importance of hygiene.
- ✓ Provide clean restrooms with soap, clean water, and single-use towels.
- ✓ Post signs in restrooms and enforce hand washing.
- ✓ Provide non-food contact jobs for sick employees.

Monitor Wash Water Quality

- ✓ Use potable water for all washes.
- ✓ Maintain clean water in dump tanks by sanitizing and changing water regularly.
- ✓ Chlorinate wash water.
 - ◆ Monitor chlorine levels
 - ◆ Maintain 150 ppm for leafy vegetables and up to 500 ppm for other crops
 - ◆ Maintain water pH at 6.0-7.0
 - ◆ Provide final rinse if using >100 ppm chlorine
- ✓ Avoid tank water temperatures more than 10°F cooler than produce temperature.

Sanitize Packing House

- ✓ Clean and sanitize loading, staging, and all food contact surfaces at end of each day.
- ✓ Exclude all animals, especially rodents and birds from the packing house.
- ✓ No smoking or eating in packing area.

Transportation and Refrigeration

- ✓ Check and clean trucks prior to loading.
- ✓ Sanitize if animals previously hauled.
- ✓ Pre-cool vehicles prior to loading.
- ✓ Ensure that refrigeration equipment is working properly.

Funding has been received from the USDA-CREES and the US-FDA to coordinate a national training program on food safety assurance for fruit and vegetable growers. The goal of the Good Agricultural Practices (GAPs) Program is to reduce microbial risks to fresh fruit and vegetables by developing a comprehensive education and extension program. While the program is based at Cornell, collaborators come from 16 states. The program objectives are to design educational materials about farm food safety and inform growers about the microbial risks that can occur on the farm. If you would like additional information about how you can reduce microbial risks on your farm, contact the Cornell GAPs Team. We can help you locate team members in your area.

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Reduce Microbial Contamination with Good Agricultural Practices

Food Safety Begins On The Farm

Outbreaks of foodborne illness make news headlines on a regular basis. In the U.S., it is estimated that as many as 76 million people contract some type of foodborne illness each year. As a result, over 325,000 are hospitalized and about 5,000 deaths occur. *Salmonella* on tomatoes and cantaloupes, *E. coli* O157:H7 on lettuce and in apple juice, hepatitis A on strawberries, and *Cyclospora* on raspberries have shaken consumer confidence in the safety of fruits and vegetables. Since 1987, the number of produce-associated outbreaks has doubled, raising concern among the produce industry, government agencies, and consumers.

From planting to consumption, there are many opportunities for bacteria, viruses, and parasites to contaminate produce. On the farm, soil, manure, water, animals, equipment, and workers may spread harmful organisms. Produce may be harvested on a farm, processed in one plant, repackaged in another, then stored, displayed, or served by an institution or in the home. Each of these steps is an opportunity for harmful microorganisms to enter the food supply.

How much foodborne illness originates on the farm? **No one knows.** Are there reasonable steps that a grower can take to reduce the risk that pathogens will contaminate the food produced on the farm? **Absolutely.**

Clean Soil

The improper use of manure can be a risk factor contributing to foodborne illness. Pathogens such as *E. coli* O157:H7, *Salmonella*, and *Campylobacter* can be present in manure slurry and soil for up to 3 months or more, depending on temperature and soil conditions. *Listeria* may survive on vegetables growing in the soil, even though it may not survive in the soil itself. *Yersinia* may survive in soil for up to 330 days. Composting manure, incorporating it prior to planting, and

avoiding top-dressing with fresh manure are important steps that can reduce the risk of contamination while making use of this important source of nutrients. Excluding domestic and wild animals as much as possible from production fields will help reduce the risk of manure (fecal) contamination.

Clean Water

When using surface water for irrigation, test quarterly for fecal coliforms, especially if water passes close to sewage treatment or livestock areas. Make sure that water used for produce cooling, washing, dipping, and processing operations is drinkable (potable). Whenever possible, use chlorinated water. Always make ice with potable water.

Clean Hands

Attention should be paid to worker hygiene in the field and the packing house. Workers who pick, sort, grade, or pack produce **must** wash their hands after using the restroom. Hepatitis A outbreaks have been linked to infected workers. Teach workers about microbial risks. Provide soap, clean water, and single-use towels in the field and insist that all workers wash hands before handling fruits and vegetables.

Clean Surfaces

Before harvesting or packing and at the end of each day, clean all bins and work surfaces. Sanitize surfaces using recommended chemicals and procedures (consult local extension service for specific recommendations).

There is no way to guarantee that everything we grow and consume is free of harmful microbial contamination. The risk can be reduced if preventative steps are taken before produce leaves the farm. This brochure contains detailed suggestions on how you can reduce risks of microbiological contamination on the farm.