



— On The Farm —



THE UNIVERSITY OF GEORGIA
**COOPERATIVE
EXTENSION**

College of Agricultural and Environmental Sciences
College of Family and Consumer Sciences

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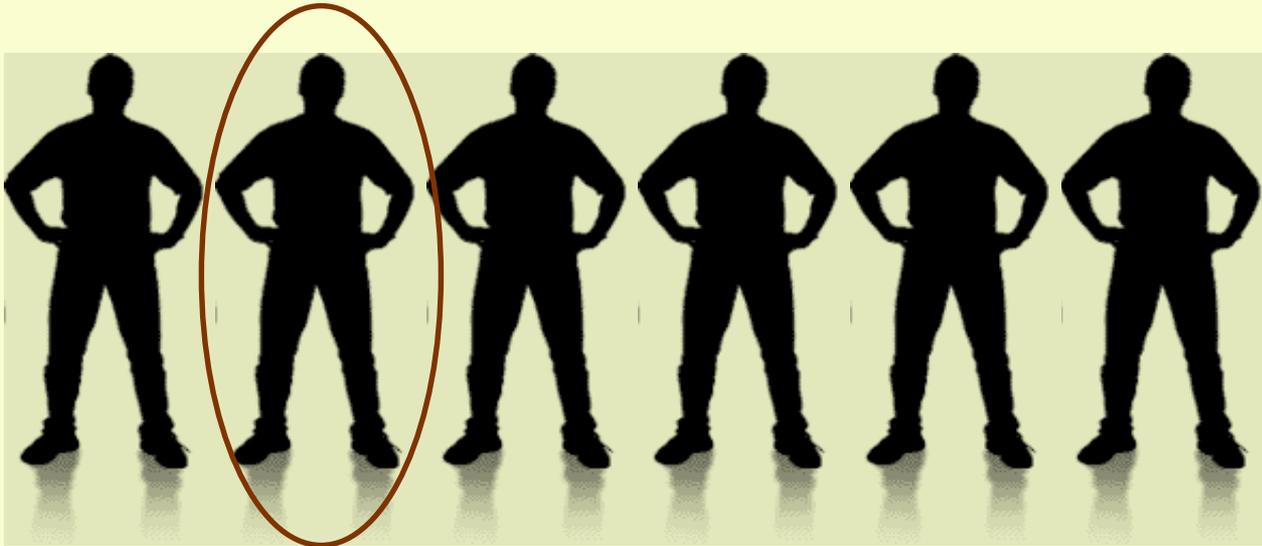
Objectives

In this session, you will:

- Gain knowledge about potential issues that could affect the safety of produce
- Evaluate practices seen on farms
- Become familiar with “best practices” and procedures to enhance the safety of produce grown and marketed locally

(Activity)

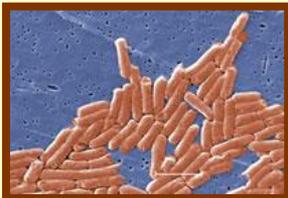
Foodborne illness in the US Each Year



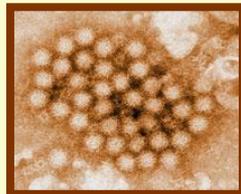
- 1 out every 6 Americans
- 128,000 hospitalizations
- 3,000 deaths

What is foodborne illness?

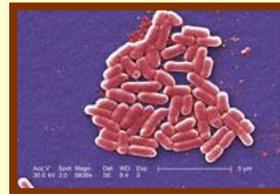
- Any disease caused by food that you eat
- Illnesses caused by bacteria like *Salmonella*, *Listeria*, *E. coli* O157:H7, *Yersinia*
- Illnesses caused by viruses like norovirus
- Illnesses caused by parasites like *Cryptosporidium*, *Cyclospora*, *Toxoplasma*
- Illnesses caused by parasitic protozoans like *Giardia*



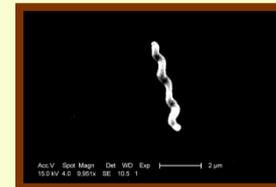
Salmonella



Norovirus



E. coli O157:H7



Campylobacter



Listeria

What's the big deal?

Symptoms:

- Diarrhea
- Vomiting
- Nausea
- Abdominal pain
- Fever



Complications:

- Reactive arthritis
- Guillain-Barre syndrome
- Spontaneous abortion, stillbirths
- HUS (kidney failure)
- TTP (blood clots, can lead to stroke)
- Death



Liability?

Table 1
Compensation in Court Cases by Severity Category, 1988-97*

Illness Severity	Court Cases with Award Information	Percent Won by Plaintiff	Average Award
Premature death	6	66.7%	\$274,580
Hospitalized & survived	60	31.7%	\$141,199
Other cases	109	29.4%	\$110,916

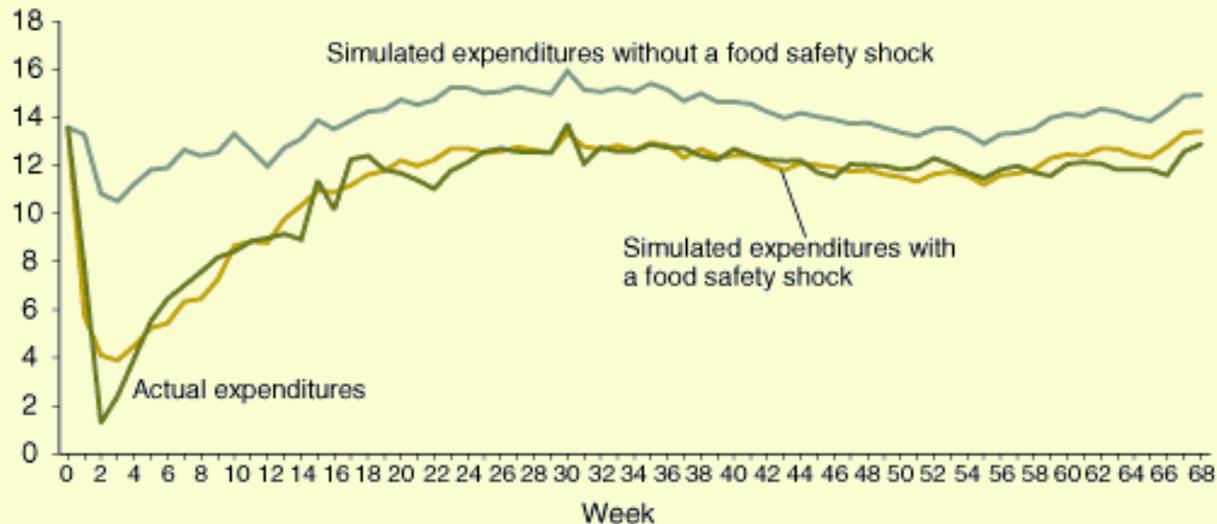
* Only 175 of 178 court decisions had award information. All awards are in 1998 dollars.

Buzby et. al, Economic Research Service, USDA,
Agricultural Economic Report 799.
www.ers.usda.gov/publications/aer799/aer799.pdf

Loss of business?

Bagged spinach expenditures plunged in response to FDA announcement, September 2006 - December 2007

Expenditures (\$ millions)



Note: Week zero is the week prior to and week 1 is the week of the announcement. Since the data are weekly and the 5 days when there was no spinach on the market were spread over weeks 1 and 2, the figure does not show actual expenditures falling to zero.

Source: USDA, Economic Research Service model results.



Produce Associated Outbreaks

From 1996 to 2007:

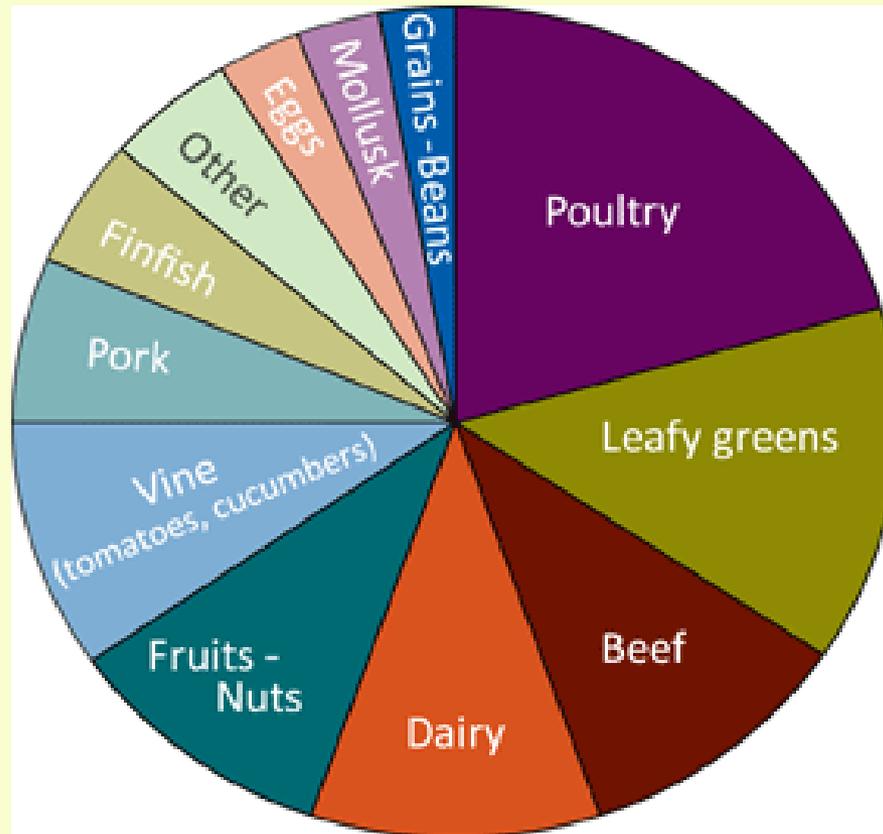
Approximately 72 reported outbreaks of foodborne illness associated with about 20 fresh produce commodities, both domestic and imported

- 13 outbreaks were associated with tomatoes
- 11 outbreaks were associated with melons
- 24 outbreaks were associated with leafy greens such as lettuce and spinach

(lettuce, juice, sprouts, berries, green onions, nuts)



Causes of Foodborne Illness Outbreaks



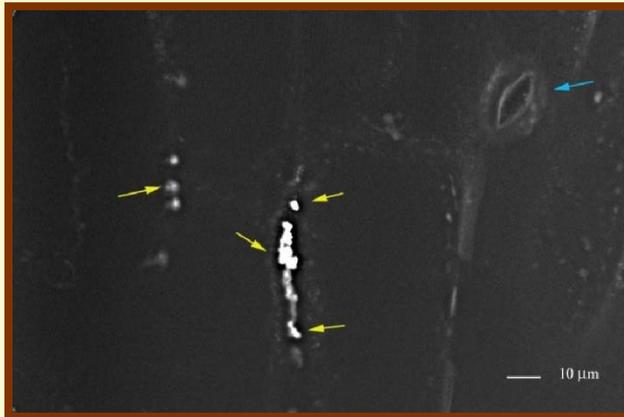
Causes of illness in 1,565 single food commodity outbreaks, 2003–2008
CDC. 2011. www.cdc.gov/foodborneburden/cdc-and-food-safety.html

The problem...

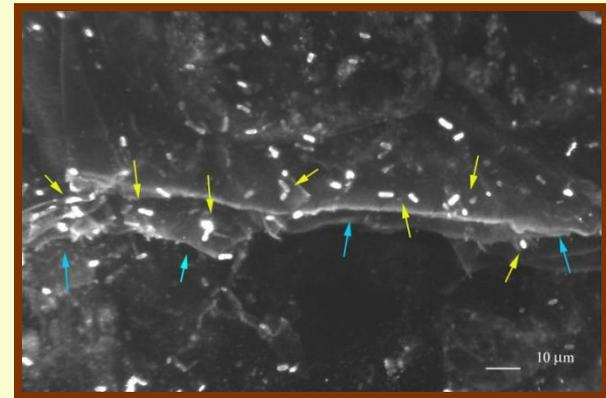
- Once produce is contaminated, it's difficult, if not impossible to remove contamination



Courtesy of Dr. Joseph Frank, University of Georgia Dept. of Food Science and Technology



E. coli O157:H7 attached to a break in the waxy cuticle on lettuce leaf surface



E. coli O157:H7 on the cut edge of lettuce leaf

Courtesy of Dr. Joseph Frank, University of Georgia Dept. of Food Science and Technology

The goals...

- Don't let produce get contaminated with pathogens in the first place.
- Handle produce to minimize growth of harmful pathogens.



How do we do this?

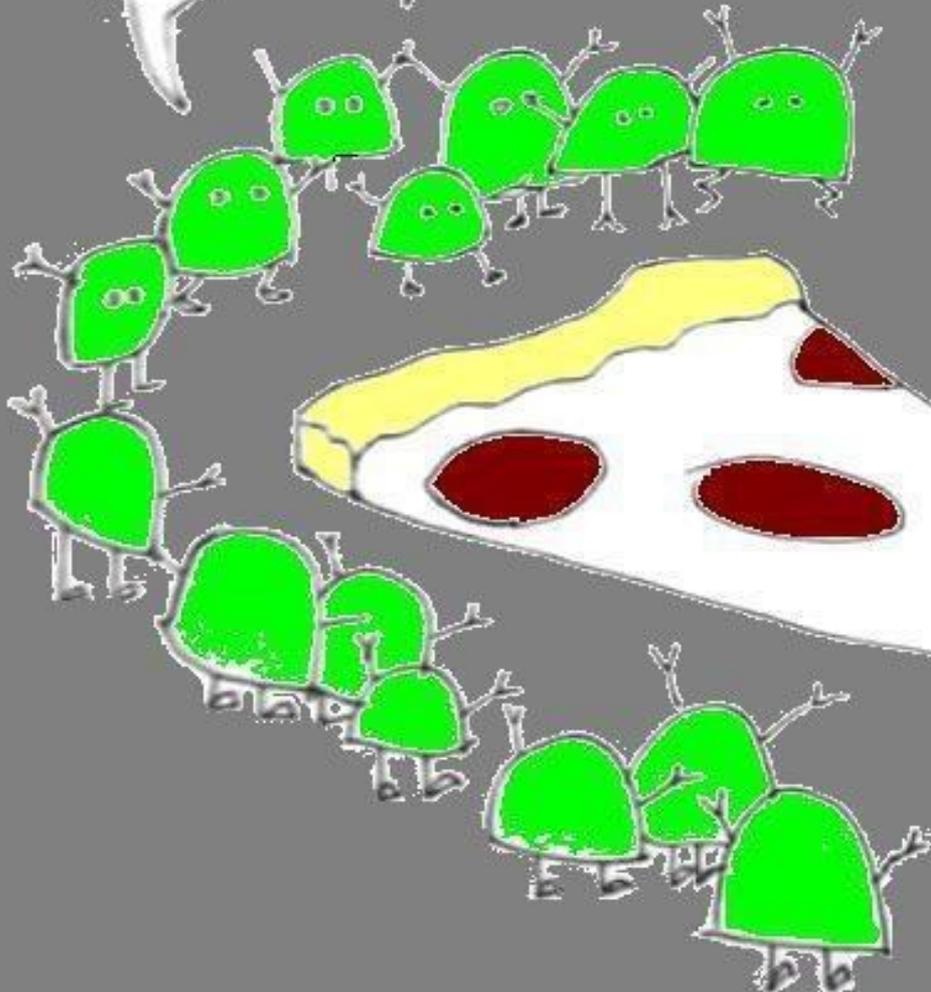
- Examine current practices of farmers
- Identify potential practices that could be areas of risk
- Develop “best practices” to reduce risk
- Develop practices appropriate for farm size to reduce risk

1st Step – Survey of farmers in three states



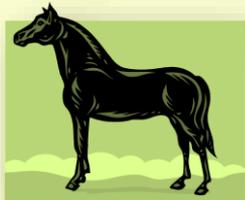
A gift! Germs,
ATTACK!!

NO! We must
wait five
seconds!



Farm Surveys – Use of manure

- 57% of 226 respondents indicated they used manure
- Poultry litter was the most commonly used manure (45% of those who used manure)
- Poultry (36%) and cattle manures (31%) were also commonly used
- Horse manure, goat manure, bat guano were used by some farmers
- Most interesting response
 - Humanure – composted human waste (1 respondent)



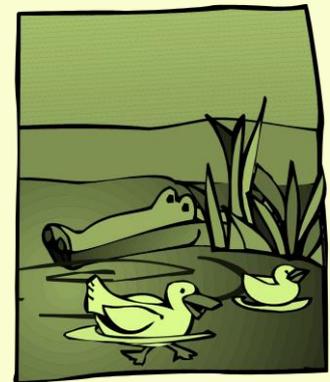
Farm Survey – Manure waiting period

- The U.S. EPA and the National Organic Program require:
 - 90 day waiting period after raw manure application for crops that do not touch the soil – tomatoes, corn, etc.
 - 120 day waiting period for crops that touch the soil – carrots, turnips, etc.
- 47% of respondents waited 120 days after raw manure application to harvest
- 27% waited less than 90 days



Farm Survey – Irrigation water source

- 50% used water that had been tested or municipal water
- 27% used untested water or water from streams, ponds, or lakes



Farm Survey – Worker hygiene

- 67% have handwashing facilities near field or packing facilities
- 66% have bathrooms near field or packing facilities
- Good but need to do better



Farm Survey - Post-harvest handling

Although many growers have good practices:

- 43% do not use sanitizers on surfaces that touch fruits and vegetables
- 18% do not use some type of cooling method on farm
- Approximately 17% use untested water - either well water or surface water to rinse produce
- 35% do not cool produce while it is transported to the market



Farm Survey - Post-harvest handling

- Only 33% always clean containers used to transport produce between each use
 - Of those who clean produce containers:
 - most (46%) use soap and water
 - 26% only use water
- 30% rarely or never clean the vehicle between each use
 - Of those who clean transport vehicles, most use:
 - water and detergent (34%)
 - water and bleach (23%)



Farm Survey – Worker training

- 41% train their workers in sanitation practices for harvesting, cleaning, or packing crops

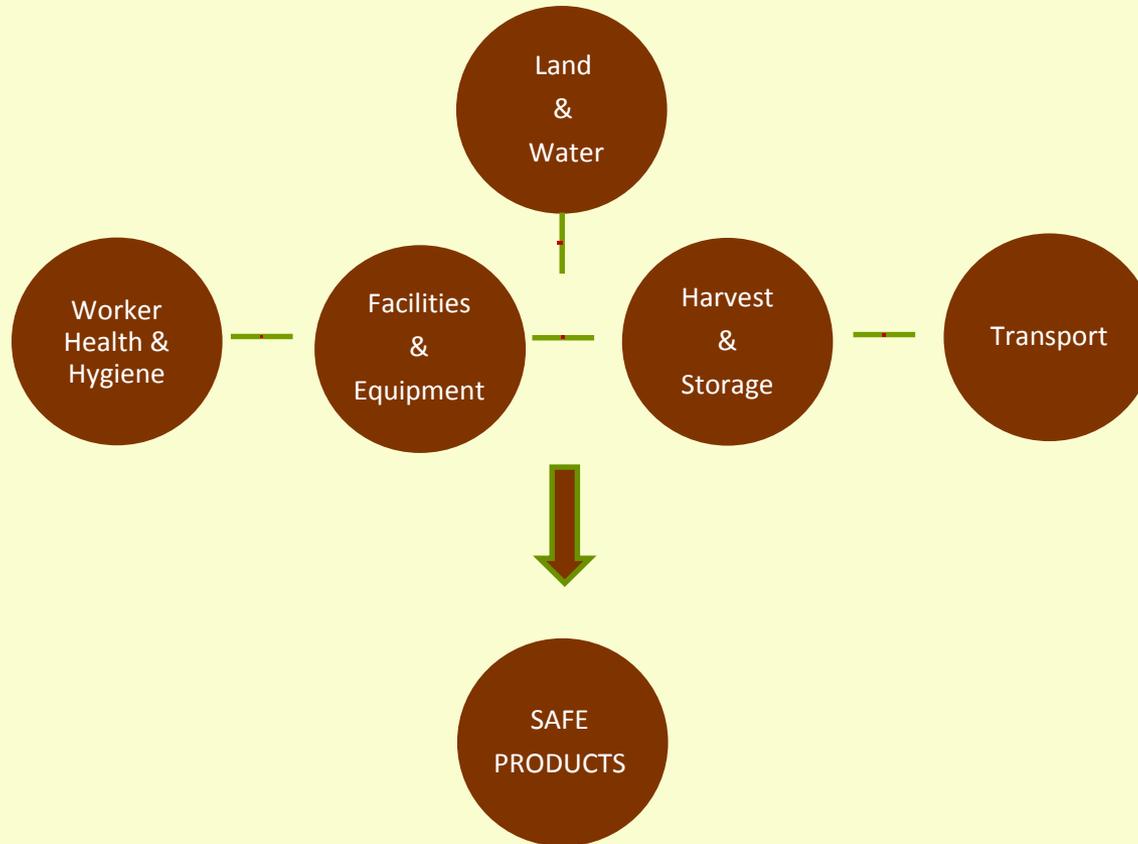


Farm Survey – Markets for produce

- Markets for produce
 - 53% sell in Farmer's Markets
 - 21% sell to restaurants
 - 26% sell through CSAs
 - 24% sell wholesale



Farm Food Safety Model



Basic Steps to Keep Products Safe

Land
&
Water

- Use clean land and soil
 - Minimize human pathogens in the soil
 - Follow safe guidelines for manure use
 - Observe the specific waiting period between raw manure application and harvest
 - 90 day waiting period after application for crops that do not touch the soil – tomatoes, corn, etc.
 - 120 day waiting period for crops that touch the soil – carrots, turnips, etc.
-

Basic Steps to Keep Products Safe

Land
&
Water

- Use clean land and soil
 - Follow guidelines for proper composting
 - Pile size – beginning at 5x5x5 feet
 - Carbon to nitrogen ratio 25:1
 - Temperatures between 131 and 170°F
 - Maintain for 3 days in vessel
 - Maintain for 15 days in windrow or pile
 - » Turn at least 5 times
 - Use a thermometer and check the temperature

Basic Steps to Keep Products Safe

Land
&
Water

- Use clean water - Best practice
 - Well water preferred to surface water
 - Monitor water quality – test well water at least once a year
 - Use water that is safe to drink to rinse fruits and vegetables, etc.



Basic Steps to Keep Products Safe

Land
&
Water

- If you must use surface water to irrigate
 - Test frequently
 - Use drip irrigation rather than overhead irrigation
 - Best practice - wait two weeks after last application to harvest
 - Keep pets, farm animals and wild animals out of surface water used for irrigation



Basic Steps to Keep Products Safe

Worker
Health &
Hygiene

- Stress good personal hygiene in fields and packinghouses
 - clean clothes, no jewelry, no eating, no drinking, no smoking, etc.
- Teach workers how and when to wash their hands



Wet
Hands



Apply
Soap



Rub Hands
Together at
least 20 sec &
Clean Nails



Rinse
Hands



Dry With
Clean Paper
Towel



Use Towel to
Turn Faucet
& Open Door

Basic Steps to Keep Products Safe

Worker
Health &
Hygiene

- Exclude sick workers from handling produce
 - Diarrhea, vomiting, GI upset – wait until symptom free for at least 24 hours
 - Jaundice – require a doctor's release
 - Sore throat, etc. – reassign to non-food-handling, non-container-handling duties



Basic Steps to Keep Products Safe

Facilities
&
Equipment

- Provide adequate bathroom facilities
- Provide adequate handwashing facilities



Within $\frac{1}{4}$ mile from each worker in the field or packing shed



Basic Steps to Keep Products Safe

Facilities
&
Equipment

- Wash and sanitize work surfaces, packing bins, utensils, etc.
 - Pressure washing
 - Detergent
 - Type needed varies by situation
 - Sanitizer
 - Strength needed varies by situation

TRAIN WORKERS!



Basic Steps to Keep Products Safe

Facilities
&
Equipment

- Procedure:

- Rinse

- Wash

- Rinse

- Sanitize

- Example:

- Food contact surfaces – 200 ppm chlorine

- 1 tablespoon plain household bleach per gallon of water

- Surfaces not contacting food – 400 ppm chlorine

- 2 tablespoons plain household bleach per gallon of water

Basic Steps to Keep Products Safe

Harvest
&
Storage

- Practice good personal hygiene
- Use clean and sanitized equipment
- Label plots and containers (traceability)
- Wash produce before entering packing facility
- Different containers for field and market
- Clean storage areas



Basic Steps to Keep Products Safe

Harvest
&
Storage

- Monitor storage temperatures
 - Removing field heat as soon as possible preserves quality and enhances safety
 - Lower temperatures lower the growth rate of most microorganisms
 - Most can be stored at 41F; some susceptible to chill injury

www.caes.uga.edu/applications/publications/files/pdf/FS%20100_2.PDF









Basic Steps to Keep Products Safe

Transport

- Clean transport equipment and vehicles between uses
- Keep produce cool during storage and transport to maintain quality and enhance safety



What “best practices” do you see in this picture?



Basic Steps to Keep Products Safe

Transport

ANSWER:

- Lidded container
- Ice for cooling
- Plastic for ease in cleaning & sanitizing



Find the Mistakes Activity -
UF Video

So what does it all mean?

- Any produce, whether organically grown or conventionally grown, whether from your own back yard or thousands of miles away, can be contaminated if it is not handled properly all the way from the farm to the market.



Is it ridiculous to expect these practices?

Is it overkill?

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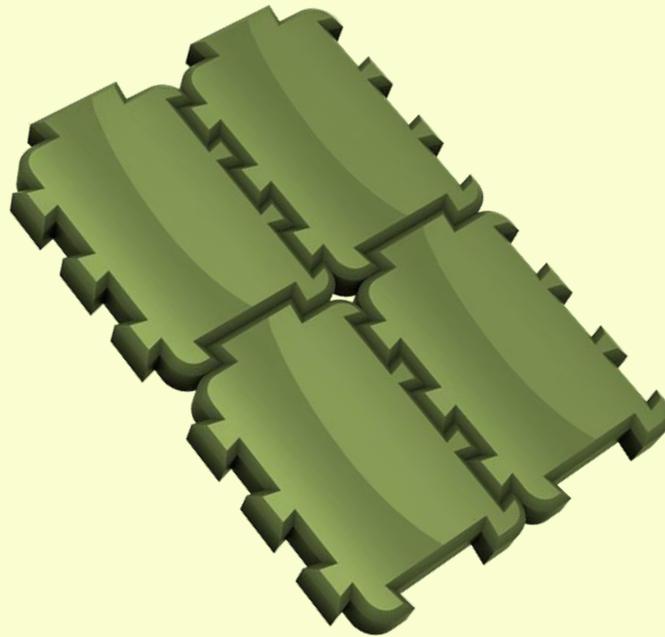
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Show “due diligence” to make your products safe.

- Take steps to follow best practices
- Keep some records

Food Safety Plans On the Farm

Put all the pieces together and you've got a food safety plan.



Enhancing the Safety of Locally Grown Produce – On The Farm Video

Examples of how other
farmers have implemented
“best practices” to produce
safe products

Where do I begin to make my products safer?

- Farm self-help form (in hand-out packet)
 - Go back to your farm and complete this form. A “no” answer to any question means you may need to make a change in that practice.

Enhancing The Safety of Locally Grown Produce
Farm Self-Help Form

Practice	YES	NO	DOES NOT APPLY TO ME
Training & Certifications			
Our farm has established food safety rules and practices.			
Our farm has completed food safety trainings and/or certification courses.			
Our farm has records of certification or evidence of training to help ensure food safety.			
Land & Water Use			
I know the land use history, whether the farm was previously used for livestock production or has a history of application of biosolids, septage or other by-products containing feces.			
My crop production areas are separate from or NOT located near dairy, livestock or fowl production areas or where run-off from such areas could be possible.			
If crop production areas are near or adjacent to dairy, livestock or fowl production areas, I make sure natural or physical barriers will prevent contamination of the produce growing area by wind or water.			
If I use raw animal manure, I wait at least 120 days between application and harvest for crops touching the soil and 90 days for other crops.			
I NEVER use septage or untreated human manure in crop production.			
Any composted manure I use follows the National Organic Program recommendations for temperature, turning and time to reduce disease-causing microorganisms.			
I have my well water that I use for irrigation tested for the presence of bacteria.			
I NEVER use untreated surface water (ponds, lakes, streams or springs) for overhead irrigation.			
I use municipal water or tested well water for overhead irrigation.			
I have my well water that I use for rinsing fruits and vegetables tested for the presence of bacteria.			
I NEVER use surface water (ponds, lakes, streams or springs) for rinsing fruits and vegetables.			
Farm Worker Hygiene			
I have policies in place to limit sick workers from coming in contact with fruits and vegetables.			
I provide sanitation training for my workers.			
I provide training for my workers on proper glove use.			
My workers have access to handwashing facilities with clean water, soap and paper towels within a short walking distance of my fields.			

Practice	YES	NO	DOES NOT APPLY TO ME
My workers have access to toilet facilities within a short walking distance of my packing areas.			
I train my workers to seek immediate first aid for injuries like cuts, abrasions, etc. that could be a source of contamination for produce.			
I have trained my workers on what to do with produce that comes in contact with blood or other bodily fluids.			
Facilities & Equipment			
Toilet facilities are serviced and cleaned on a regular schedule.			
Handwashing facilities are cleaned and stocked with clean water, soap and paper towels on a regular schedule.			
Harvesting equipment (knives, pruners, machetes, etc.) is kept reasonably clean and is sanitized on a regular basis.			
Harvesting containers and hauling equipment are cleaned and/or sanitized between uses.			
Surfaces that come in contact with fruits and vegetables at my farm are cleaned and sanitized regularly.			
Damaged containers are properly repaired or discarded.			
Any cardboard boxes used are new and only used once.			
Storage & Transport			
Produce is handled carefully and packed securely to prevent bruising and injury.			
I cool fruits and vegetables after harvest.			
Produce is kept cool during transport to market.			
Containers used with fruits and vegetables are cleaned and sanitized between each use.			
The vehicle is NOT used to transport animals, raw manure, chemicals or any other potential contaminants.			
The vehicle used to transport fruits and vegetables is cleaned frequently.			

If you answered "no" to any of the questions, those questions represent areas where changes or improvements may help your farm to offer safer products, attract more customers because of your commitment to food safety and reduce potential risk of foodborne illness.

Publication #2016-0016, 10/16 | This document was supported in part, by a grant from the National Institute of Food and Agriculture, United States Department of Agriculture (check number 2009-14110-20061). February 2012
 The University of Georgia and the North Carolina State University, the U.S. Department of Agriculture and counties of the state supporting Cooperative Extension, the University of Georgia College of Agricultural and Environmental Sciences and Family and Consumer Sciences. Additional program activities are provided by local extension agents who, like others across the country, are part of the National 4-H and Cooperative Extension System. Contact your local extension office.

Where do I begin to make my products safer?

- Specific information can be found in factsheets in hand-out packet

– On the Farm (overview of food safety)

– Land Use

– Water Use

– Manure Use

– Farm Worker Hygiene

– Farm Worker Toilet and Handwashing Facilities

– Harvesting and Storage

– Transporting Produce Safely

– Training and Certification Options

Enhancing The Safety Locally Grown Produce
On the Farm

When you are done to be able to get you need to know that your food is safe. Many consumers are looking to local farmers and farmers markets as a source for safe, nutritious, & local foods.

- Food safety begins on the farm. Produce must be planted, grown, harvested, stored and transported using a variety of "best practices." These "best practices" help to prevent contamination of the produce with harmful disease-causing microorganisms or pathogens, as they are called, and promote growth of an overall business that may be profitable.
- The goal of a food safety plan on your farm is to prevent produce from becoming contaminated and not to allow harmful bacteria to multiply to higher enough numbers to cause illness, cause death, cause children and people with existing health problems to be more susceptible to foodborne illness than healthy adults. Food safety plans should focus on preventing contamination of produce.
- Think about possible sources of contamination. You can create a complete plan. If you just think about one area, there are many pieces that fit together. If you just focus on one or two pieces, the puzzle pieces will be unable. However, if you put all the pieces together, you have a plan for keeping your produce safe.

Figure 1. Model of food safety on the farm.

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graph TD; A[Land Use] --> B[Harvest & Storage]; B --> C[Transport]; C --> D[SAFE PRODUCE]; E[Farm Worker Health & Hygiene] --> B; F[Facilities & Equipment] --> B; G[Manure Use] --> B; H[Water Use] --> B; I[Training & Certification] --> B;
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Enhancing The Safety Locally Grown Produce
Manure Use

Although manure is a valuable source of nutrients, it is also one of the greatest potential sources of pathogens that can cause foodborne illness. These pathogens can be found in the feces of humans, pigs, and wild animals. Manure can also contain harmful bacteria such as *E. coli*, *Salmonella*, *Campylobacter*, and *Listeria* sp. as well as viruses and parasites. Pathogens can survive in manure slurry or on the soil for three months or more. Human manure, raw or composted, should never be used on food crops because of the risk of contamination with harmful microorganisms that cause disease in humans. The following steps will help you reduce potential contamination from other types of manure.

Composting

Produce contaminated by manure is still pathogenic. For this reason, the minimum temperature of the compost pile needs to reach between 137° and 157° and be maintained at those temperatures for specific lengths of time. These minimum temperatures are recognized by both the U.S. Department of Agriculture and the U.S. Environmental Protection Agency as effective for killing pathogens.

- Composting is a useful or an essential daily job. These temperatures have to be maintained for at least three days. If using a windrow or pile that is not aerated, annual temperatures have to be maintained for 15 days, and the pile has to be turned at least once. Turning helps any animal that might be in the manure of the pile when temperatures are lower allowing pathogens to survive to be heated into the manure during the composting process. Record when the pile is turned.
- For small scale composting, make sure the beginning pile is at least 1 x 1 x 1 foot. Smaller piles do not generally have enough mass to retain heat and reach the needed temperature. A program of materials with a carbon to nitrogen ratio of about 12:1 will help the pile heat quickly.
- Use a thermometer to make sure the proper temperatures are being reached. The center of the pile is the best place to check. Turn the pile every 10-14 days. Turn the pile every 10-14 days. Turn the pile every 10-14 days. Turn the pile every 10-14 days.
- Do not use the compost pile as a source of water. It should be used for soil amendment only. Do not use the compost pile as a source of water. It should be used for soil amendment only. Do not use the compost pile as a source of water. It should be used for soil amendment only.
- If using compost that contains manure, make sure to use the compost was produced according to the standards listed above.

Raw Manure Use

Raw manure can be used with certain precautions:

- Do not use manure to build healthy soils with cover crops or crops that do not touch the soil.
- Do not use raw manure on leafy and vegetable crops with raw manure.
- Do not use raw manure on the soil. Do not use raw manure on the soil.
- Always wait at least 90 days before harvesting any crop where the wildlife problem does not come in contact with the soil after incorporation of raw manure, such as tomatoes, peppers, etc.

Enhancing The Safety Locally Grown Produce
Water Use

Water is an essential part of life and an essential part of any farm. It is necessary for growing produce and other activities on the farm. Water is also used for cleaning produce before it is sold. Water must also be used for cleaning equipment on the farm. Ensuring that you have clean water on the farm for these uses is an important part of ensuring contamination by disease-causing microorganisms and pathogens. There are many pathogens such as *Salmonella*, *Escherichia coli*, and *Listeria* that can cause illness in humans.

Irrigation Water

Irrigation water usually comes from either wells or surface water sources such as ponds or streams. Irrigation water is considered good, but it is often an expensive option. Although irrigation water will minimize contamination risk, it is usually not feasible to use for irrigation. Ponds and water are also a good choice. Surface water can be used with certain precautions.

Well water: Wells can be either drilled or bored. Bored wells can usually draw from 20 to 50 feet deep and have a larger diameter (width of two to three feet). They are sometimes lined with concrete and have concrete caps. Bored wells are usually of a higher quality construction and maintenance. They can have a higher potential for contamination than drilled wells. Older bored wells are usually not sealed water that can allow pathogens moving down the casing of the well casing through gaps in the concrete casing caused by worn grout or seals.

Drilled wells: Drilled wells are usually deeper and, depending on the geology of the area, are usually lined with concrete. Because these wells are deeper, they are usually more contaminated by microorganisms. They are often of a higher quality construction and maintenance and can be used for produce into the water supply.

The wellhead location is also important for minimizing risk.

- Do not locate wellheads in areas that receive runoff from nearby animal agricultural areas, manure storage areas, or composting areas.
- Do not locate wellheads within 100 feet of manure storage, water tanks or ditches.

Surface water: Ponds and streams can be used for irrigation, but be very aware of how much water is available from the water source. Customers are not always granted or have limited access to the deepest water (higher level) of contamination.

- Exclude animals (including waterfowl and pigs) from ponds used for irrigation water.
- Avoid using surface water after heavy rainfall until the sediments have settled, and the water is clear again. Research has shown pathogens are higher in stormwater and sediments.
- Use drip irrigation when practical. In general, drip is preferred to overhead irrigation because the water is less likely to soil and splash produce of the crop. This is particularly true when using surface water sources.
- Avoid overhead irrigation of produce within two weeks of harvest. This can reduce risk but is not an absolute guarantee of safety.
- Consider irrigating early in the day. If overhead irrigation must be used, sunlight and drying can reduce the level of pathogens.
- Avoid overhead irrigation of produce within two weeks of harvest. This can reduce risk but is not an absolute guarantee of safety.
- Be aware that traveling water is likely to be a source for pathogens, so take care to minimize contact with the surface of produce.

My business is “growing”, but how can I grow my business?

- Food safety is good marketing.
 - Visit www.onfarmfoodsafety.org to develop a free food safety plan
 - Consider certification programs such as GAPs.
 - Contact your local Cooperative Extension office.
-
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— On The Farm —

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Publication #FDNS-E-168-21

February 2012

The University of Georgia and Ft. Valley State University, the U.S. Department of Agriculture and counties of the state cooperating. Cooperative Extension, the University of Georgia Colleges of Agricultural and Environmental Sciences and Family and Consumer Sciences, offers educational programs, assistance and materials to all people without regard to race, color, national origin, age, gender or disability.

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This project was supported all, or in part, by a grant from the National Institute of Food and Agriculture, United States Department of Agriculture (Award Number 2009-51110-20161).



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