NC MARKETREADY™

Fresh Produce Safety – Field to Family

A Program of NC Cooperative Extension

Module 1:
Introduction to Fresh Produce Safety

Acknowledgments

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Module 1: Introduction to Fresh Produce Safety

Estimated duration: *1 hour*

Instructional overview: This is simply a PowerPoint presentation that can be used as an introduction to food-borne illness and Good Agricultural Practices (GAPs).

Instructional objectives:

- Develop an understanding of food-borne illness and the agents associated with produce.
- Upon completion the participant should:
  - Understand the differences among a virus, a bacterium and a parasite and where they may contaminate produce
  - Identify other chemical and physical contaminants.
  - Be able to distinguish the concept of GAPs.

Equipment, supplies and materials needed:

- Laptop and LCD projector
- PPT presentation on CD
- Nametags, pens

Preparation needed:

- Review Module 1 and PPT before the day of the workshop.
- Become familiar with GAPs programming—how each module is an integral part of the other modules.
- Secure a laptop computer with PowerPoint capability and LCD projector.
- Save a copy of the PPT presentation (on CD) on computer. Make copies of pre-test and post-test activities (if applicable) for all participants.
- Prepare room to accommodate participants and projector. Have sign-in sheet and nametags, as applicable.

Module 1

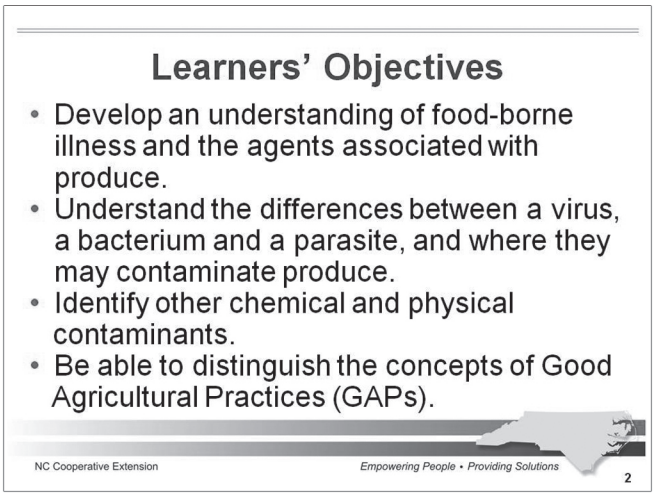
Welcome

Have participants make nametags and introduce themselves

Activity Participant Pre-test
Distribute HO 1-1 Pretest

Use Module 1 PPT to lead class discussion. Have PPT 1-1 on screen as class begins Module 1.

PPT 1-1: Introduction to Fresh Produce Safety



PPT 1-2: Learners' Objectives

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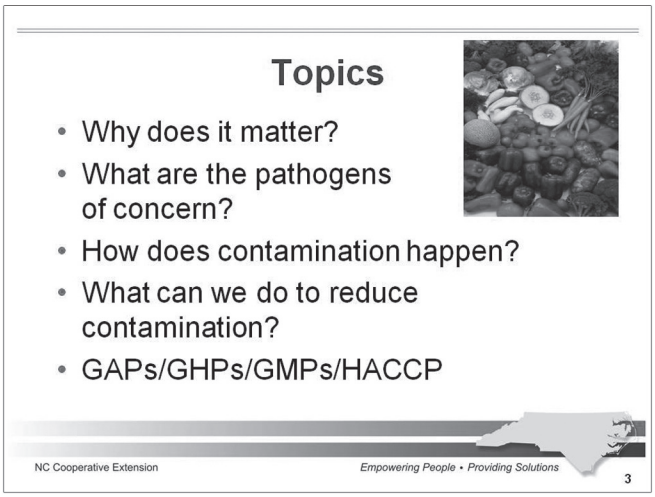
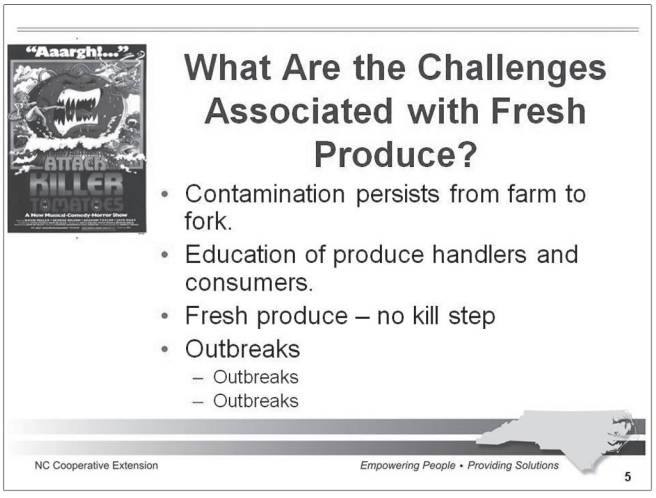


PPT 1-3: Topics

This module will help you to understand the differences among Good Agricultural Practices (GAPs), Good Handling Practices (GHPs), Good Manufacturing Practices (GMPs) and Hazard Analysis Critical Control Points (HACCP). They are all different and have different requirements.

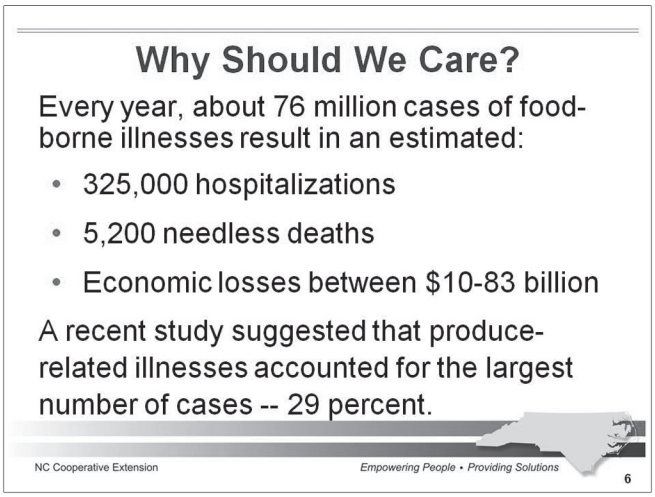
PPT 1-4: Why Is Produce Becoming a Risky Food?

We receive produce from all over the world and now expect to eat any food anytime. During winters in Chicago, I remember getting oranges only at Christmas as they were not really available or were really expensive. This does not mean that local food is safer. You have just as much chance of an outbreak occurring form local food. What it means is that the outbreaks tend to be larger and more geographically diverse, as you will see in later slides. When local food is consumed, the outbreaks tend to be smaller and more localized.



PPT 1-5: What Are the Challenges Associated with Fresh Produce?

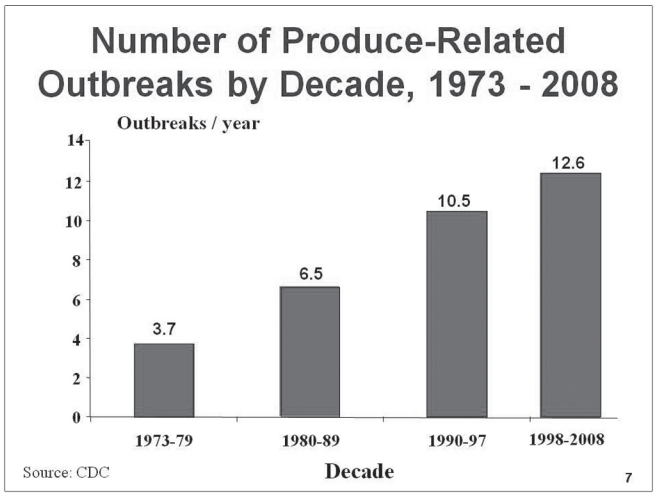
Outbreaks of food-borne disease challenge the production methods and economics of the fresh produce industry.



PPT 1-6: Why Should We Care?

It is important to remember these data are from 1998. While we suspect the number of illnesses has decreased, their economic impact is probably larger—more than $100 billion.

Source: Mead et al. and Hoffman (*Journal of Food Protection* 70, p. 1220.)



PPT 1-7: Number of Produce-Related Outbreaks by Decade,1973-2008

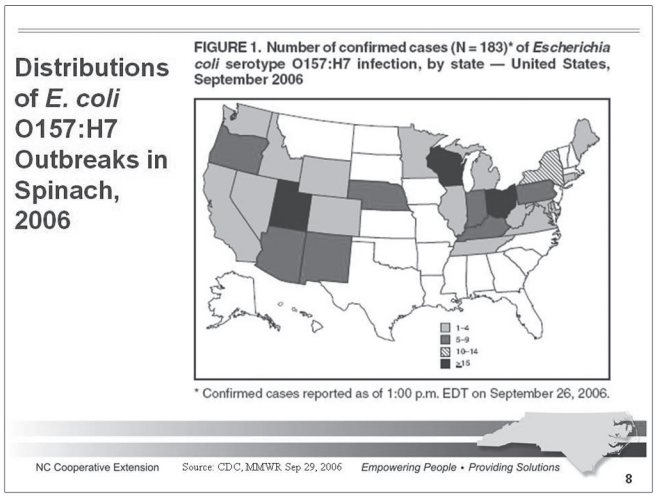
Since 1973, outbreaks of food-borne diseases associated with fresh produce have continuously increased. This slide and the next few slides show data collected from the Foodborne Disease Outbreak Surveillance System of the Centers for Disease Control and Prevention (CDC). Because this is a passive reporting system consisting of reports of investigated outbreaks of food-borne disease sent to CDC by state health departments, these data are not all inclusive.

PPT 1-7 (continued)

Since our database contains information from 1973-79, 1980-89 and 1990-97, for the rest of this talk I will refer to these time periods as the 1970s, 1980s and 1990s. This graph shows the number of fresh produce-associated outbreaks per year by decade.

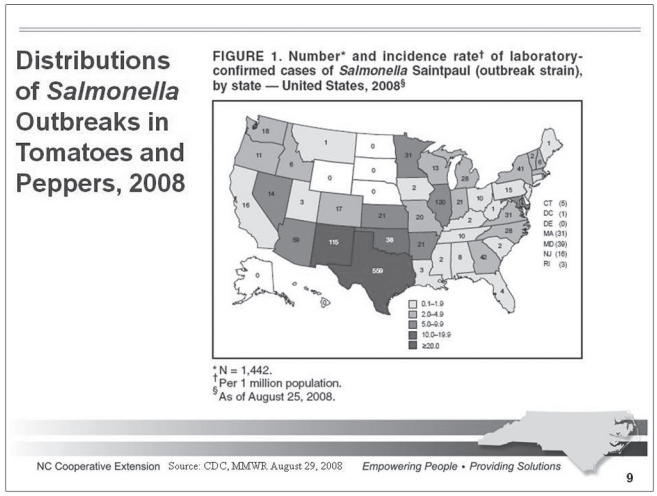
The number of outbreaks per year increased from 3.7 in the 1970s to 10.5 in the 1990s.

Currently, more than 12 outbreaks a year are attributed to produce. (Source: Federal Drug Administration [FDA])



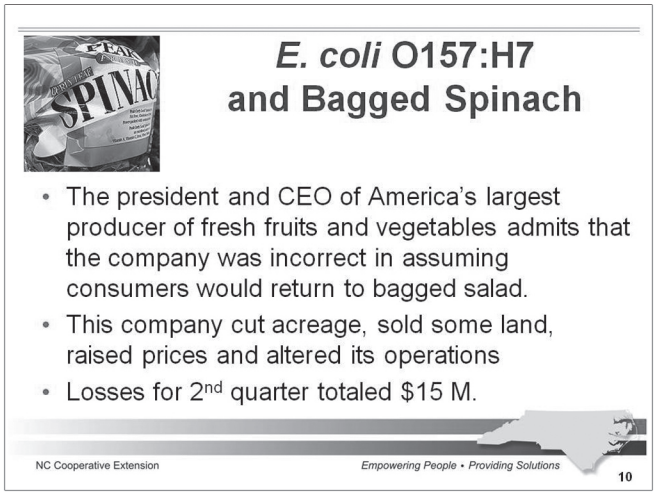
PPT 1-8: Distributions of *E. coli* O157:H7 Outbreaks in Spinach, 2006

This is an good example of the widespread outbreak that can occur in fresh produce, here specifically spinach. According to the FDA, 1,000 pounds of spinach caused the outbreak. A total of 23 states were affected, with 205 confirmed cases of *E. coli*. Of these, 103 patients were hospitalized and three died. It should be emphasized that this outbreak occurred from bagged spinach, one reason the outbreak was tracked well. Nationwide distribution of bagged spinach shows how produce distribution practices have changed.



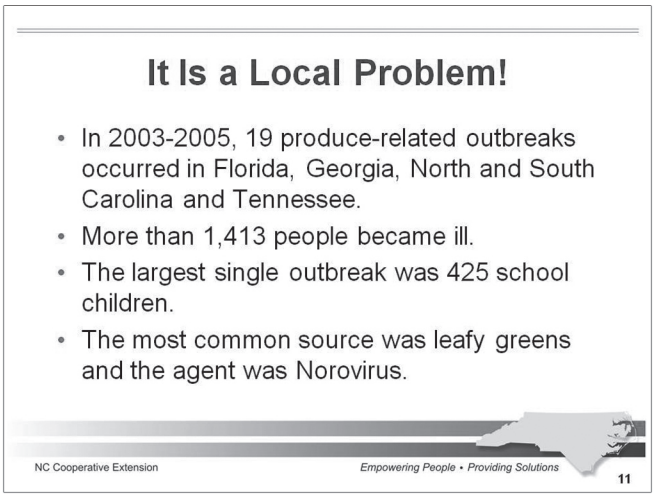
PPT 1-9: Distributions of *Salmonella* Outbreaks in Tomatoes and Peppers, 2008

You can see that unless you live in the Dakotas, Nebraska or Kansas, this outbreak affected your state. Its economic effects are still being felt and had a great impact here even though we were not harvesting tomatoes at that time. The outbreak costs Florida more than $100 million and Georgia about $14 million. The attached Pew report is a good reference regarding the outbreak.



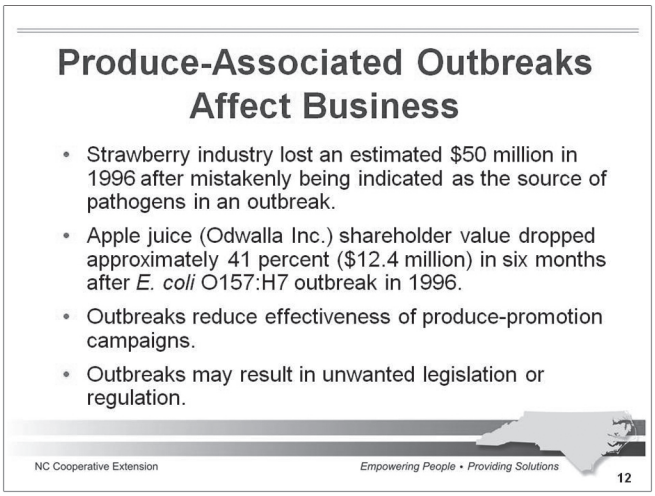
PPT 1-10: *E. coli* O157:H7 and Bagged Spinach

Additionally, this outbreak put the farm that was responsible out of business.



PPT 1-11: It Is a Local Problem!

Again this should be mentioned. "This does not mean that local food is safer. You have just as much chance of an outbreak occurring form local food. What it means is that the outbreaks tend to be larger and more geographically diverse as you will see in later slides. When local food is consumed the outbreaks tend to be smaller and more localized."

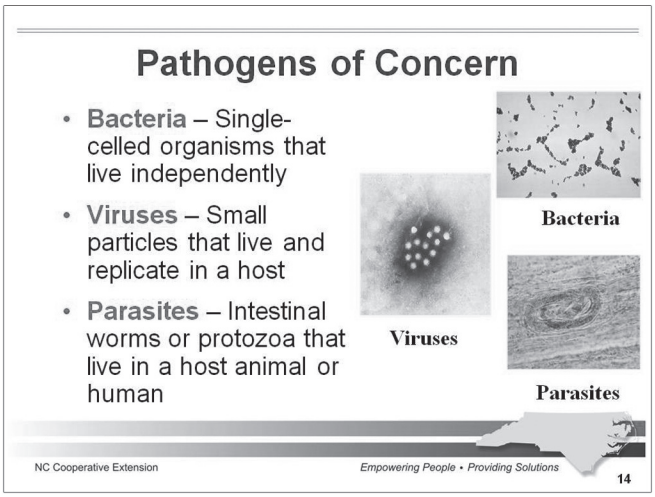


PPT 1-12: Produce-Associated Outbreaks Affect Business

In the early 1990s, Odwalla made its name by being natural limited processing. They did not pasteurize their juices. After the outbreak where one child died, they were fined $1.5 million and lost $12 million in lawsuits. The outbreak also led to regulations by the FDA requiring juice to be pasteurized.

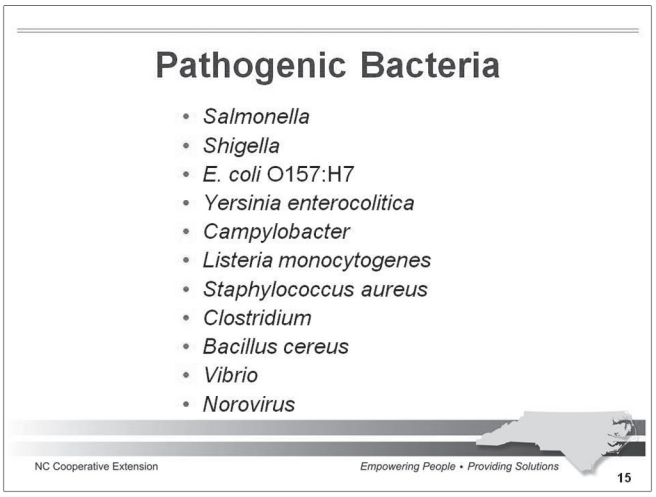
PPT 1-13: Large Chain Grocers' Response

No notes



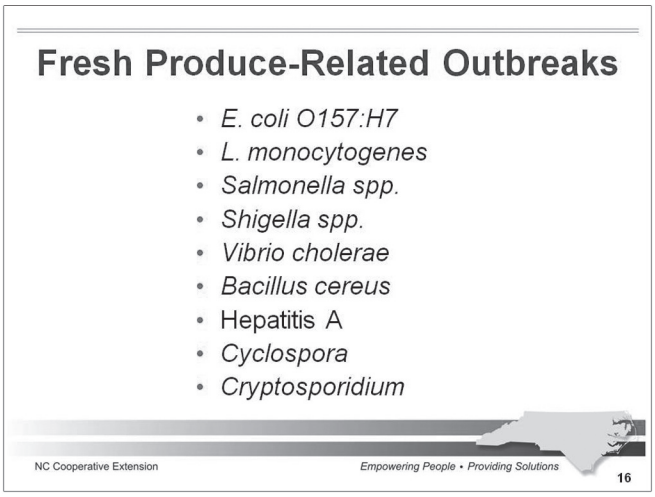
PPT 1-14: Pathogens of Concern

Of the three types of microbes, viruses are the most common cause of food-borne illness. However, bacteria are of great concern. Examples of each type of organism can be found as causes of food-borne illness. Emphasize that bacteria can grow on their own while viruses need a host. They can get on the produce only through contamination by human feces either directly or through contaminated water.



PPT 1-15: Pathogenic Bacteria

Salmonella and *E. coli* are most likely to be connected with produce, but the others have been responsible for illness in the past as well.

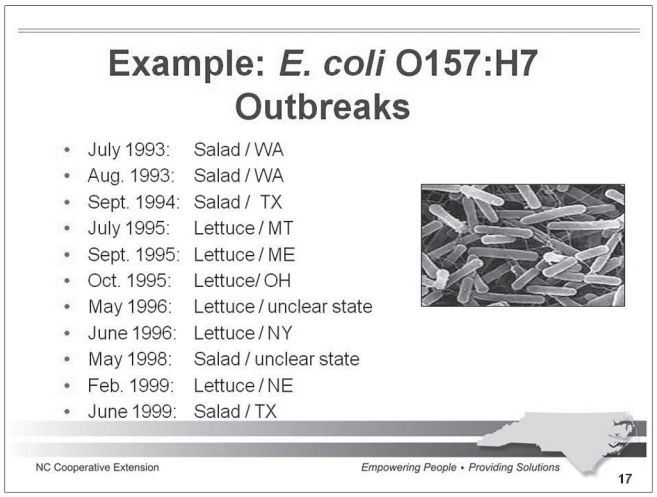


PPT 1-16: Fresh Produce-Related Outbreaks

E. coli and *Salmonella* are the most common bacterial agents. *Cyclospora* and *Crytosporidium* are parasites. Hepatitis A is a virus.

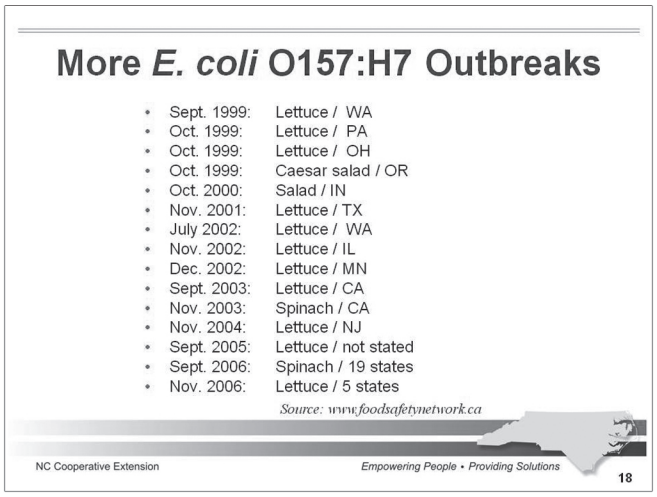
Escherichia coli (abbreviated as *E. coli*) is a bacteria. There are many different strains. Some are harmless and some can cause diarrhea, urinary-tract infections, respiratory illness and pneumonia and other illnesses.

E. coli O157:H7 refers to an enterohemorrhagic *E. coli* that can cause disease by making a toxin call Shiga toxin. It is generally this bacteria that is associated with produce outbreaks.



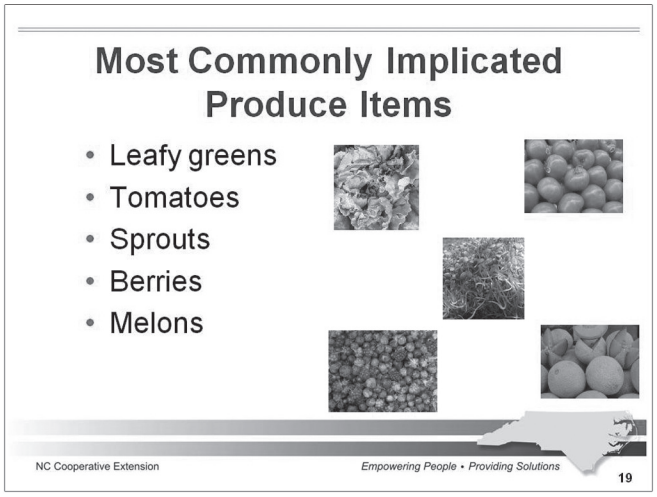
PPT 1-17: Example: *E. coli* O157:H7 Outbreaks

These next two slides are just to demonstrate the extent of the problem related to produce.



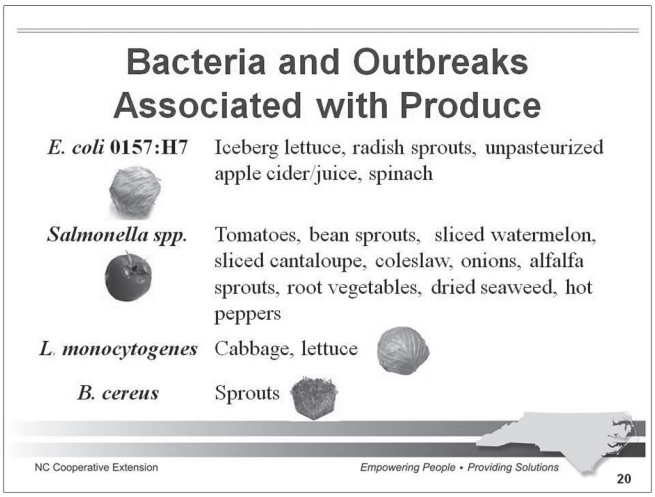
PPT 1-18: More *E. coli* O157:H7 Outbreaks

No notes



PPT 1-19: Most Commonly Implicated Produce Items

Eighteen percent of outbreaks are linked to lettuce and in the order above.

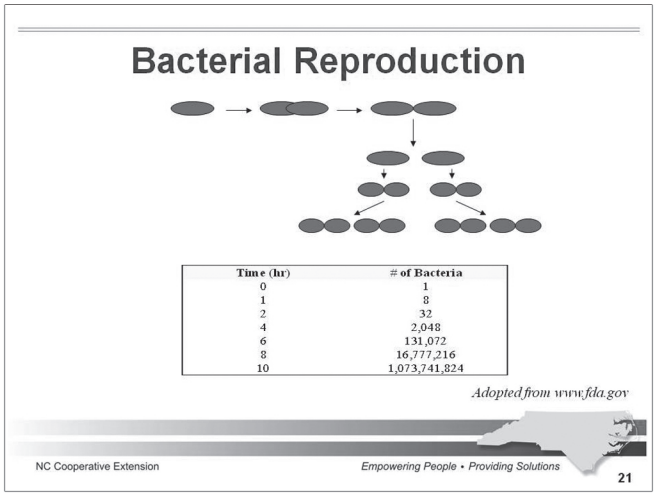


PPT 1-20: Bacteria and Outbreaks Associated with Produce

These are the general trends. The viruses can be associated with any produce item as they come from human fecal contamination. *E. coli* and *Salmonella* are carried by animals. Different strains of *E. coli* are found in our gut and are needed in the metabolism of vitamins and minerals. *E. coli* O157:H7 is a strain that is often found in the guts of cattle and deer but can be in other farm animals as well. So it enters the field really through animal feces.

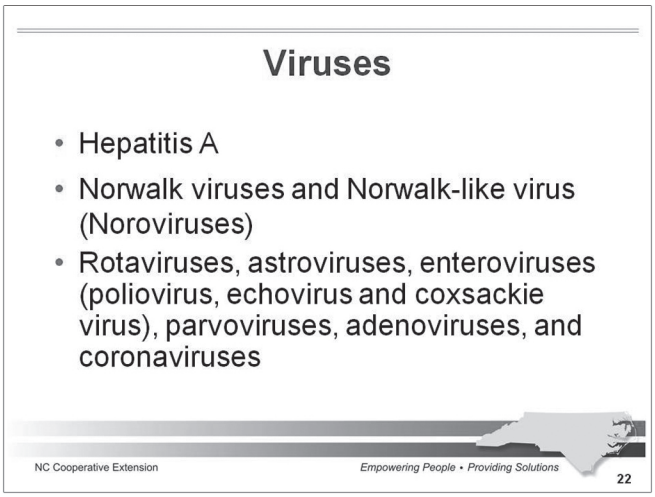
PPT 1-20 (continued)

Salmonella is often associated with the intestinal tracts of chickens and other poultry but can be found in cattle and other animals, and in humans as well. It is important to remember that not all strains of each bacterium cause disease. Only certain strains of *E. coli* and *Salmonella* make people sick. Listeria is ubiquitous or everywhere. It is a bigger problem in processing plants and deli meats but can be found in vegetables, especially those grown close to the dirt. It is the most dangerous food-borne pathogen. *Bacillus cereus* is related to anthrax but is not as dangerous. It is found in the soils. This information is also on a later slide.



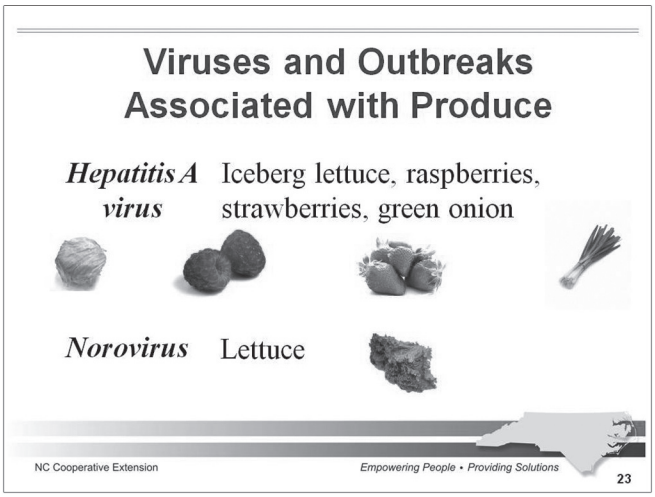
PPT 1-21: Bacterial Reproduction

Bacteria grow logarithmically; that is, one becomes two, and two becomes four. Under optimum growing conditions, bacteria can double their growth in 10 minutes, although most bacteria will do this in 20 to 40 minutes. So by cooling or lowering the pH, you can slow the growth of a bacterium. This also means that just a few bacteria can cause disease.



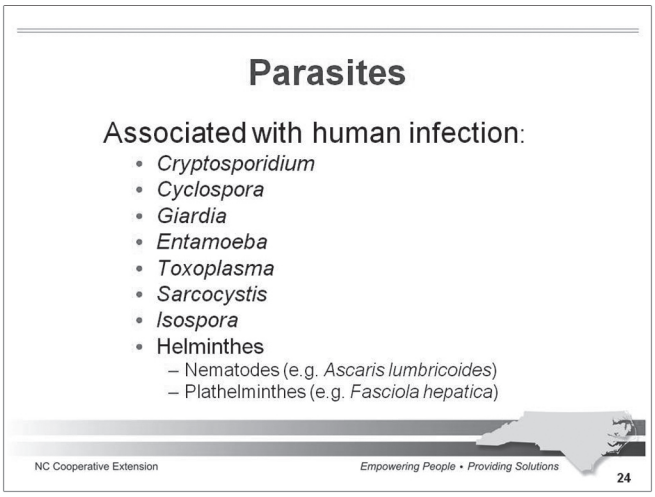
PPT 1-22: Viruses

The Norwalk virus is the most common agent of food-borne illness. It needs human cells for it to reproduce. Therefore, the only route of contamination is from human feces in contact with the mouth by means of unwashed hands or dirty water.



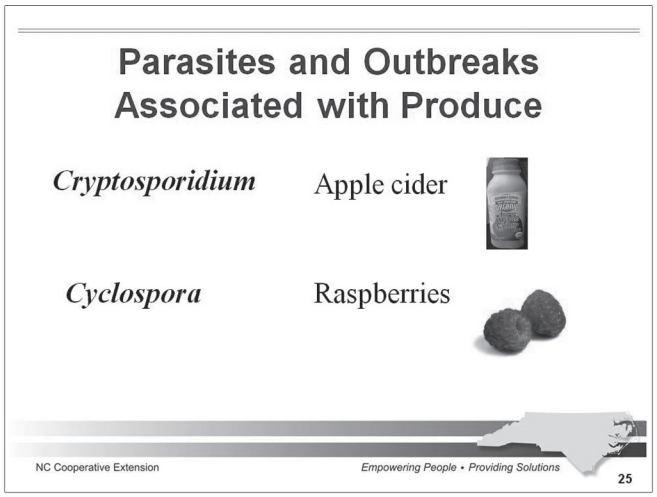
PPT 1-23: Viruses and Outbreaks Associated with Produce

These can be associated with almost any food item. They are transferred through cross contamination. A very large Hepatitis A outbreak from green onions affected 645 people and was traced to contaminated irrigation water. Virus outbreaks are also common to restaurants and cruise ships where an infected worker contaminates a food item. This is a good reason why sick workers should not work with produce but should have another assignment for the day.



PPT 1-24: Parasites

The first three are most likely with produce. They are often found in fecally contaminated water. They have a life cycle, which involves formation of a cyst. Basically they infect a human, grow and form these cysts which are transmitted through feces to the food item often through water. One of the largest outbreaks was *Giardia* which occurred in Milwaukee's drinking water and caused more than a thousand people to become ill. The cysts are very resistant to treatments such as chlorine.



PPT 1-25: Parasites and Outbreaks Associated with Produce

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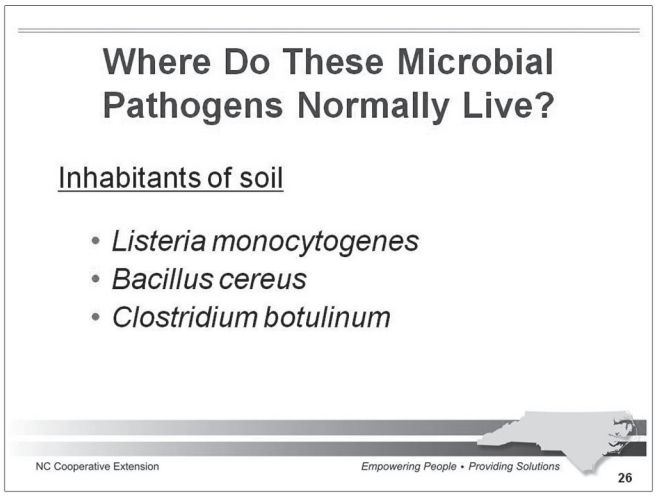
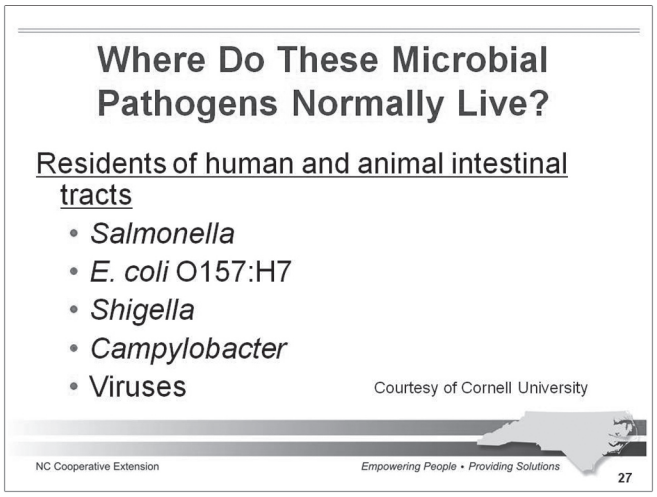


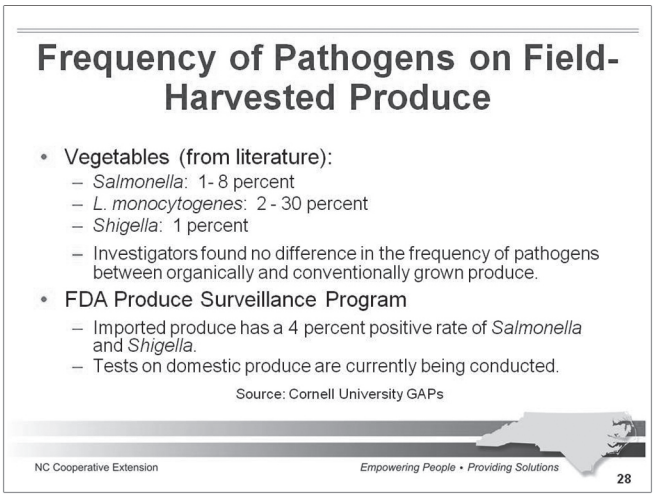
PPT 1-26: Where Do These Microbial Pathogens Normally Live?

You could find these in the soil right out the front door.



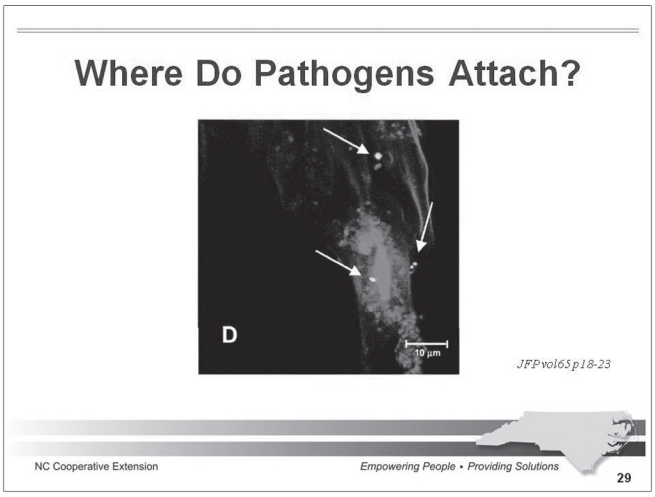
PPT 1-27: Where Do These Microbial Pathogens Normally Live?

In some studies of the fecal-oral contamination route, bacteria may survive in soil or on plants for more than 90 days. Also see notes for slide 20.



PPT 1-28: Frequency of Pathogens on Field-harvested Produce

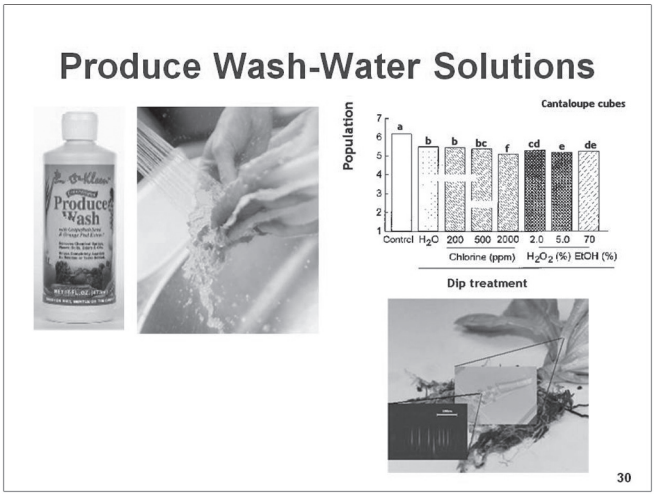
The type of produce makes more of a difference than whether it was produced organically or conventionally. It is very difficult to find the pathogens in the field. For example, a deer will not defecate all over the field but only in a small spot. If you are doing the sampling, this could easily be missed. It might even be on a different part of the plant you are testing. If it is there and that plant gets harvested, it would then be likely to infect the harvesting equipment which would then infect every subsequent plant harvested.



PPT 1-29: Where Do Pathogens Attach?

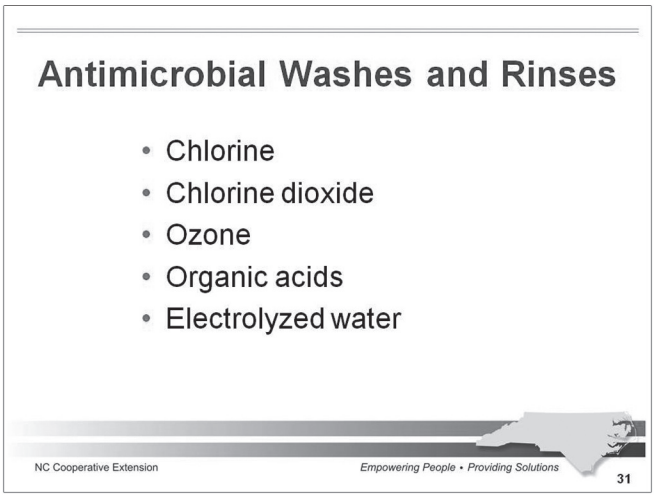
The movement of pathogens into produce can happen indirectly by attachment to the produce surface (biofilms). Stomata and cuts allow sugars and nutrients to grow. Think of the stomata or cuts as an oasis that enables food for the pathogen to grow. The attachment of these pathogens can be affected by the pathogen strain and environmental cues such as plant temperature and humidity.

(*E. coli* is stained green. The large red blotch next to the green bacteria is the stomata.)



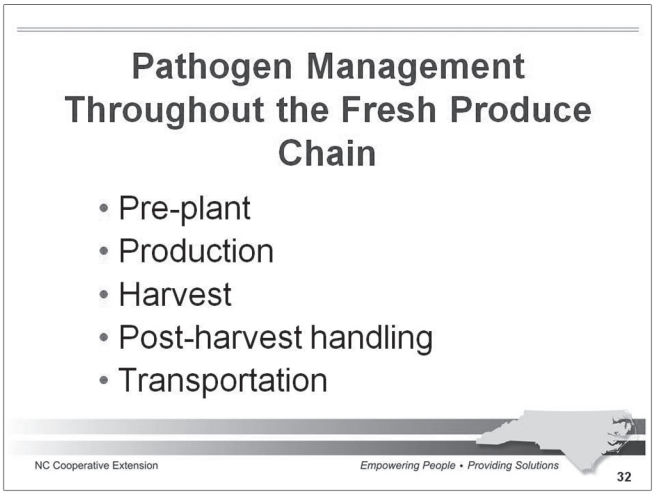
PPT 1-30: Produce Wash-Water Solutions

Many have been tried. If any were extremely effective, they would be required and produce would be much less of a problem.



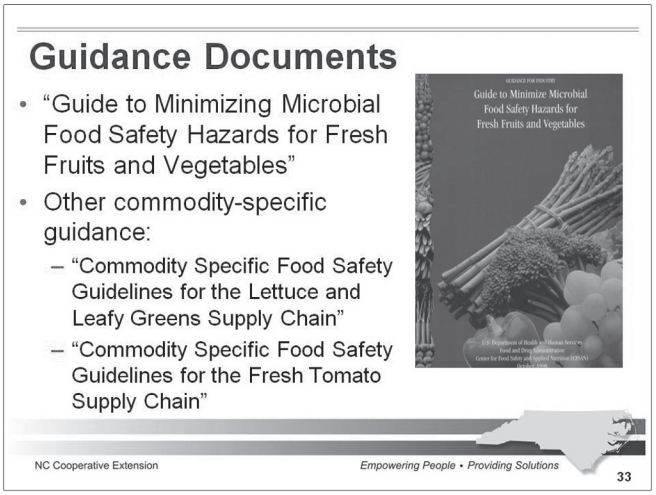
PPT 1-31: Antimicrobial Washes and Rinses

Organic acid products such as Citrox, Fresh Produce3 Wash, Aquaalive and anti-bacterial agents are effective. At best, there is a 3 log reduction in pathogen numbers—that is, 1 million pathogens can be reduced to 1,000. These agents are not useful against microbes that are internalized into the plant. The best that washes and rinses can do is prevent cross contamination. Prevention is the best tool for managing microbes.



PPT 1-32: Pathogen Management Throughout the Fresh Produce Chain

We are now trying to prevent the pathogens from getting to the produce. Since most are transmitted from feces, keeping feces out of the production chain is important.



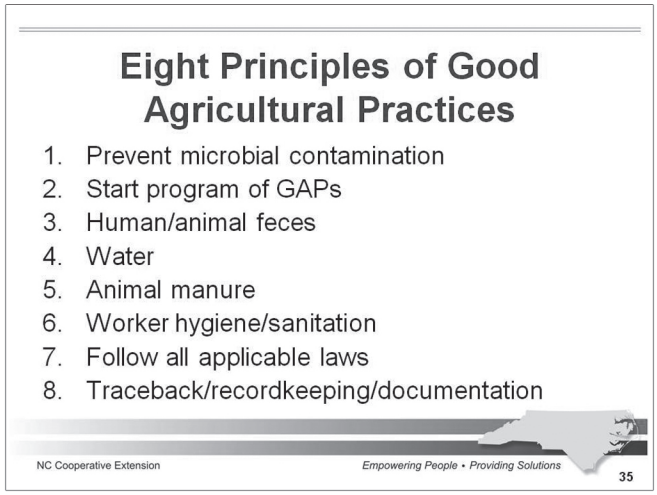
PPT 1-33: Guidance Documents

In 1998, the U.S. Food and Drug Administration (USFDA) and the U.S. Department of Agriculture issued the document "Guidance for Industry: Guide to Minimize Microbial Food Safety Hazards for Fresh Fruits and Vegetables". http://www.foodsafety.gov/~dms/prodguid.html#preface.

Please check the following website for more specific guidance documents: http://www.n cfreshproducesafety.org.

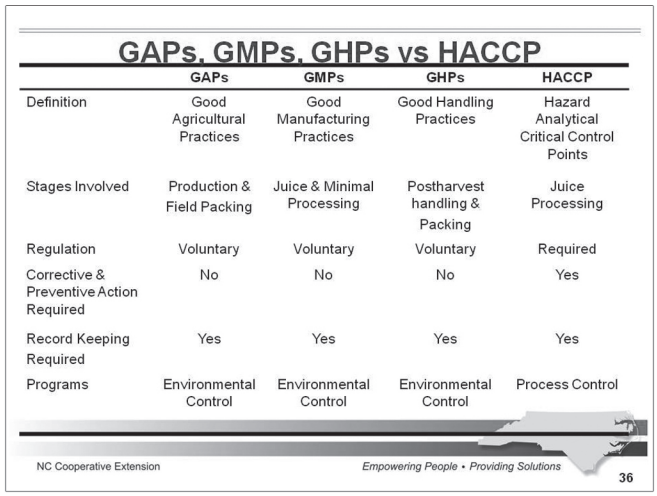
PPT 1-34: Good Agricultural Practices (GAPs)

No notes



PPT 1-35: Eight Principles of GAPs

To be GAPs-certified, a third-party auditor will come and check for proper practices in these areas. There are a number of companies and agencies that perform audits, but in reality this choice is usually dictated by the buyer. You may have only one part of an operation certified and you may have to be certified by a number of different auditors depending on your buyers. Other modules in this course deal specifically with each of these areas.



PPT 1-36: GAPs, GMPs, GHPs vs HACCP

The terms Good Agricultural Practices (GAPs), Good Manufacturing Practices (GMPs), Good Handling Practices (GHPs) and Hazard Analysis Critical Control Point (HACCP) are often confusing in a discussion of produce safety. The two most important in regards to produce safety are GAPs and HACCP. GAPs are designed for implementation in the field to prevent contamination of produce with pathogens prior to harvest. HACCP along with GMPs are used in the packing shed and in fresh-cut operations.

PPT 1-36 (continued)

GMPs in the manufacturing, packaging or holding of human food are described in the code of federal regulations title 21 part 110. These deal with personnel, buildings and facilities, equipment and production, and processing controls. The GMPs are very general and require good hygiene practices and disease control for employees, as well as training and supervision. They have further requirements for buildings and grounds, which include sanitation. Exemptions to this code are located in Sec. 110.19, as follows:

Subpart A—General Provisions

Sec. 110.19 Exclusions.

(a) The following operations are not subject to this part: Establishments engaged solely in the harvesting, storage or distribution of one or more "raw agricultural commodities," as defined in section 201(r) of the act, which are ordinarily cleaned, prepared, treated or otherwise processed before being marketed to the consuming public.

(b) The FDA, however, will issue special regulations if it is necessary to cover these excluded operations.

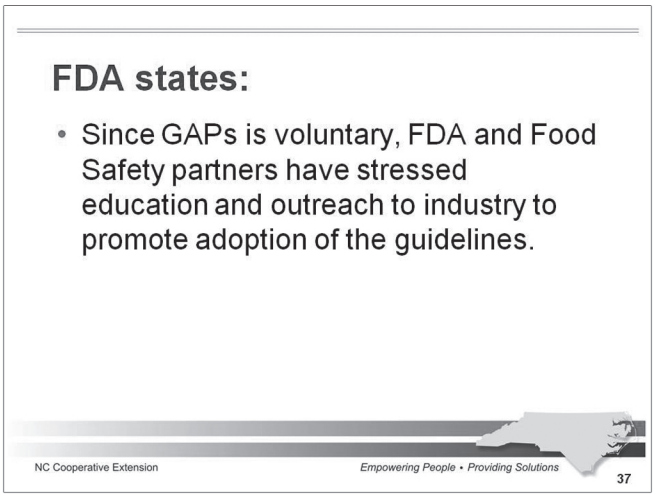
Growers would be excluded from these regulations. However, fresh-cut fruits and vegetables are considered processed and thus GMPs are required. GMPs are also the basis of any food-safety program and form the basis of many GAPs programs with regard to sanitation and the hygiene of a farm's personnel, so in essence they will be followed by GAPs-certified operations. GMPs are required or voluntary depending on the operation. HACCP is voluntary but recommended for fresh-cut fruits and vegetables.

GHPs are the section of a total GAPs program, used to minimize microbial contamination during the handling and packing of produce. GAPs are those practices that which minimize microbial contamination during the production of fresh fruits and vegetables. The eight principles of GAPs/GHPs are detailed in these modules.

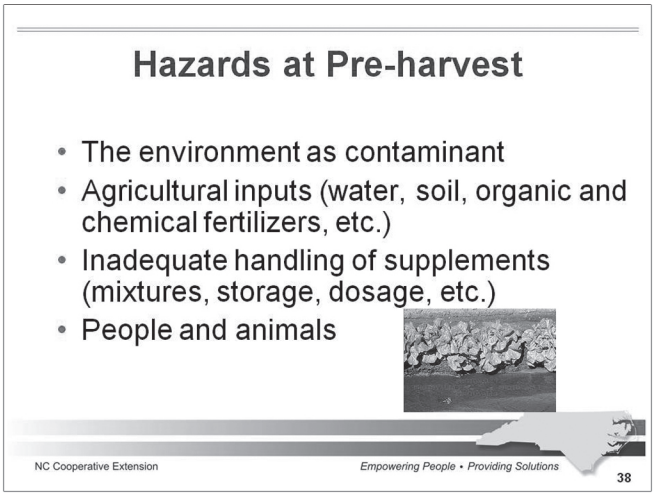
One area of confusion often deals with HACCP versus GAPs. HACCP is a preventive food safety system. HACCP has seven principles in which you identify the haz ards associated with the food product, and then identify control points during processing which control these hazards. You then monitor these control points to ensure that they will prevent the hazard in the food. A simple example of this type of process control is pasteurization of juice to prevent *E. coli* O157:H7. Instead of trying to isolate *E. coli* from the finished product you would monitor the time and temperature of your pasteurization process to ensure that the *E. coli* could not survive. Documentation, validation and corrective actions are also important aspects of a HACCP system. This system is required for most food processors including seafood, meat and poultry processors and juice processors. As there is no real critical control point in fruit and vegetable production, HACCP is not really applicable. A number of companies will, however, require that farms have a HACCP-trained individual in order to purchase the farm's produce. This is done to help facilitate interactions between the processor and the farm as it will help if someone on the farm understands the language of HACCP.

From a philosophical perspective, the major difference between GAPs and HACCP is how the control occurs. In GAPs , you are trying to prevent contamination of the product. You do your best to keep the pathogens out by, for example, monitoring your irrigation water quality. In HACCP, this is performed through your GMPs and standard operating procedures. In the HACCP system, you are monitoring a point in the process that will reduce or eliminate the pathogens, i.e. your pasteurizer.

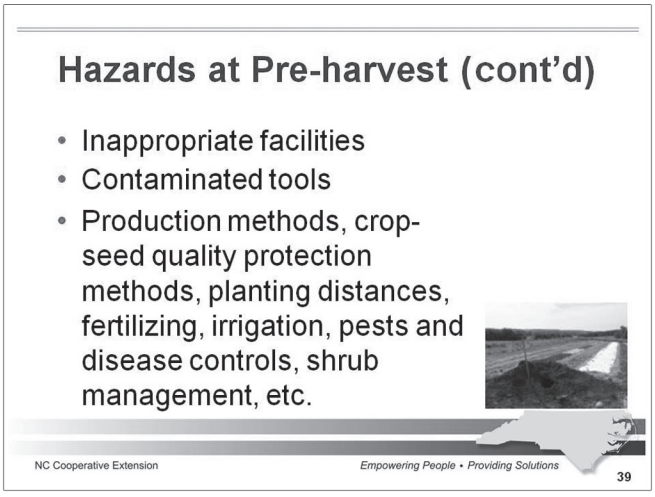
Where the confusion between GAPS and HACCP occurs is in fresh-cut operations. The "FDA Guide to Minimize Microbial Food Safety Hazards of Fresh-cut Fruits and Vegetables" (http://www.cfsan.fda.gov/~dms/prodgui4.html) suggests the use of HACCP. It is not yet required by the FDA. Various buyers will, however, have this requirement.



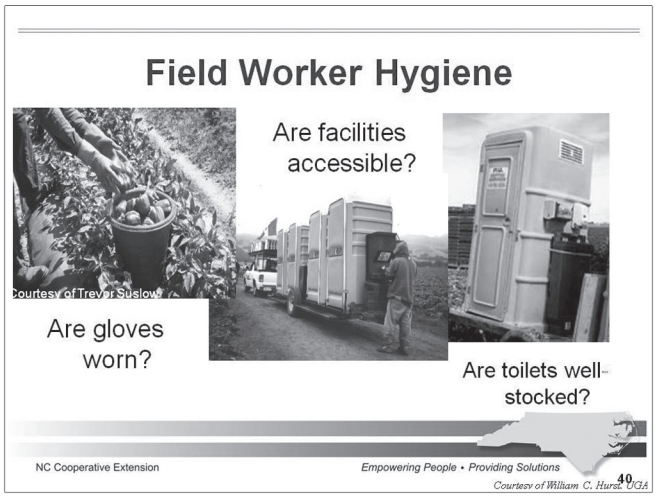
PPT 1-37: FDA states...
No note



PPT 1-38: Hazards at Pre-harvest
GAPs tries to prevent contamination through these routes because once the pathogen is on the plant it is almost impossible to remove. Don't forget that the pathogens can survive in pesticide sprays so when they are made with contaminated water you are spraying the pathogen directly onto the produce.

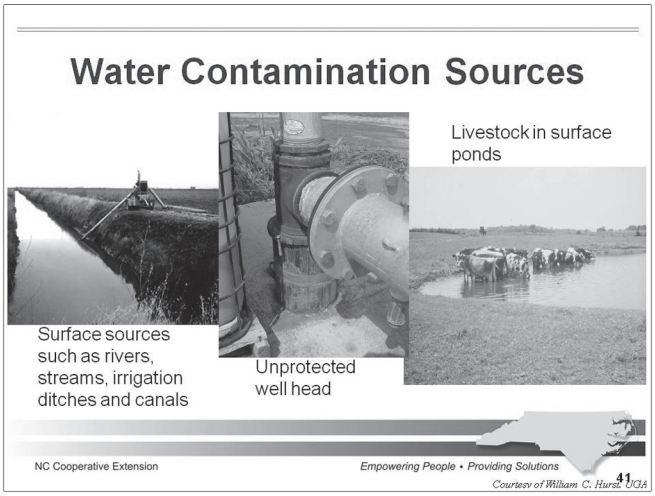


PPT 1-39: Hazards at Pre-harvest (Cont'd)
See above.



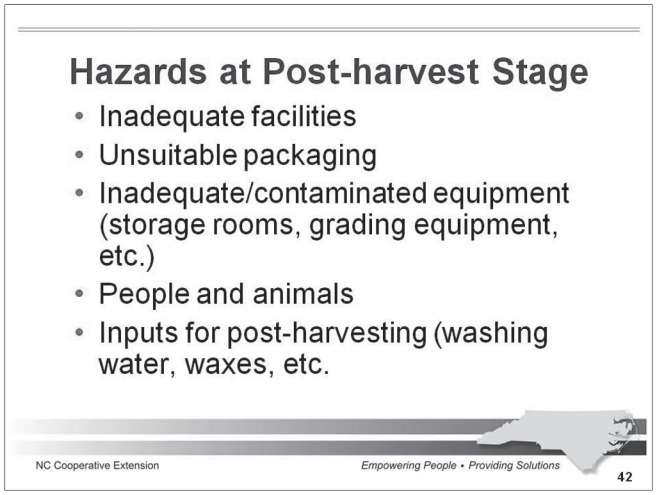
PPT 1-40: Field Worker Hygiene

We are trying to prevent feces from reaching the field. We also need to worry about sick workers as they can contaminate the produce as well. We will learn more in other modules about this issue.



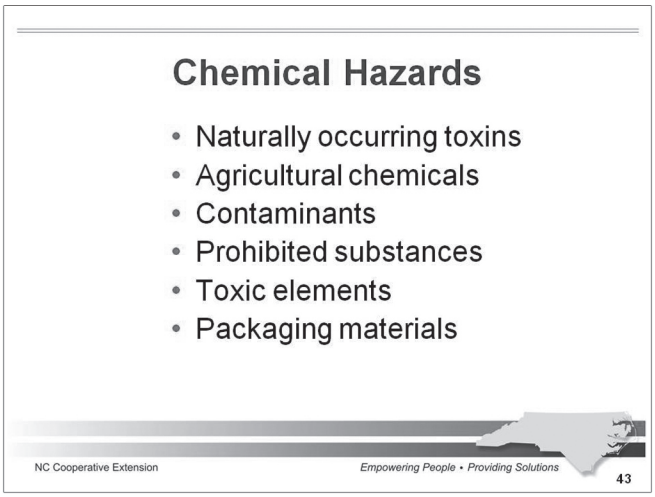
PPT 1-41: Water Contamination Sources

No notes



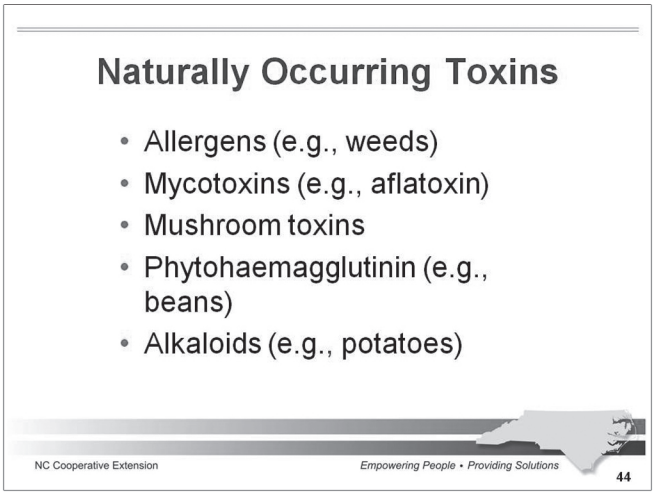
PPT 1-42: Hazards at Post-harvest Stage

No notes



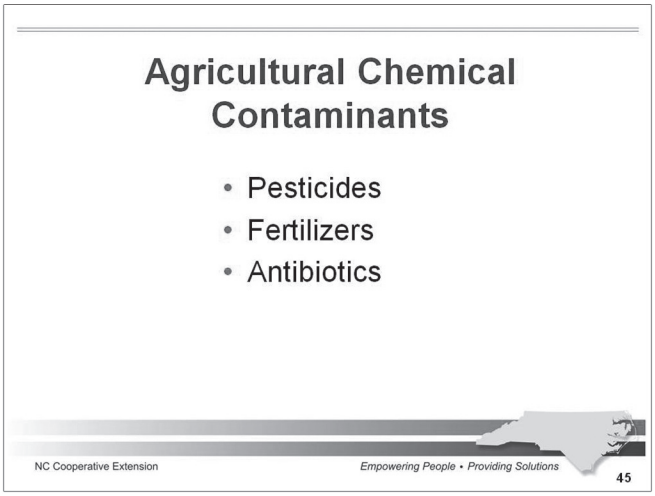
PPT 1-43: Chemical Hazards

These are generally not as common or widespread, but remember the Alar scare with apples and the melamine issues we currently have with China.



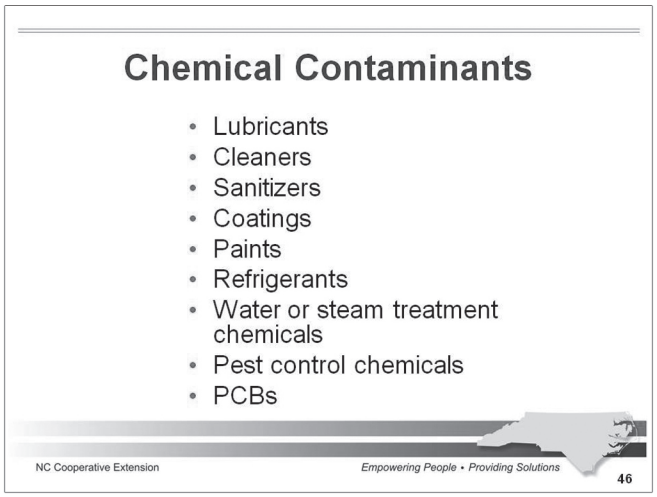
PPT 1-44: Naturally Occurring Toxins

Allergens are becoming a larger issue in the food industry. Processors have to label foods containing common allergens such as peanuts. Mycotoxins are primarily a problem associated and in some cases regulated with grains. The most relevant story here is patulin, which is a toxin produced by mold growth on apples that can be a problem. Mycotoxins typically cause cancer through long-term exposure.



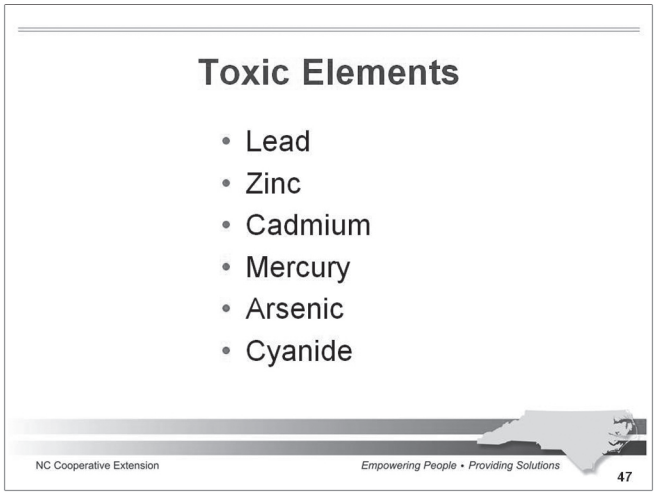
PPT 1-45: Agricultural Chemical Contaminants

See Alar.



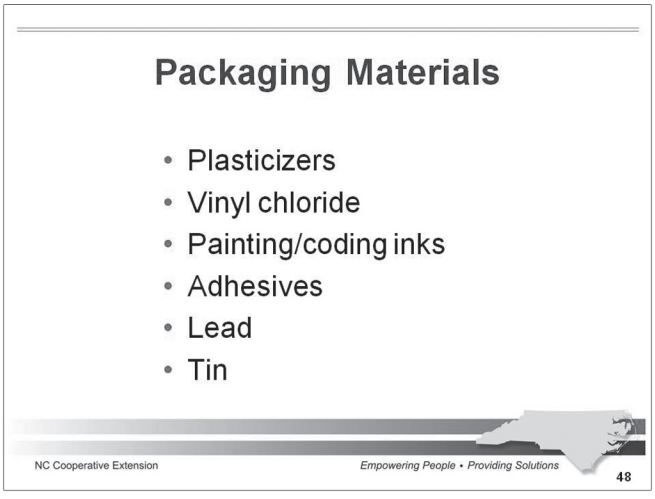
PPT 1-46: Chemical Contaminants

Many of these can come from the packing house and equipment used in the fields.



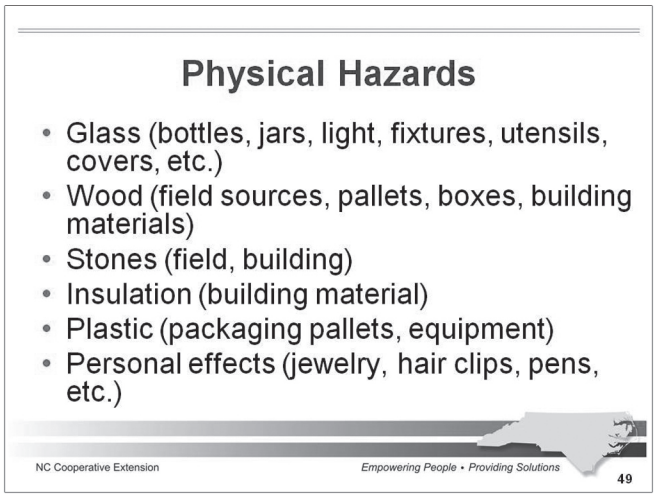
PPT 1-47: Toxic Elements

These are not often a problem in vegetable production, but you should know the history of your fields. If they were used previously by another industry, these elements could be in the soil.



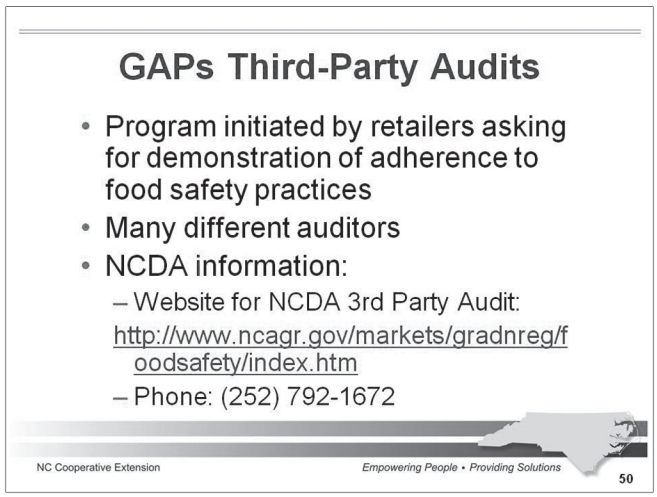
PPT 1-48: Packaging Materials

No notes



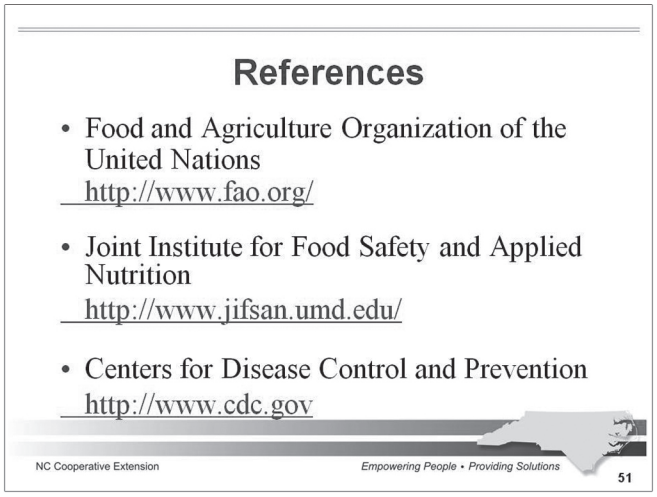
PPT 1-49: Physical Hazards

These can enter the food during harvest or from the packing house if it is not well maintained.



PPT 1-50: GAPs Third-Party Audits

No notes



PPT 1-51: References

No notes

Module 1: Introduction to Fresh Produce Safety

Pre-Test/Post-Test

ID Number/Name: _____ Date: _____

1. What types of microorganisms have been most associated with outbreaks of food-borne illness attributed to produce?
   - ❑ Bacteria
   - ❑ Viruses
   - ❑ Parasites
   - ❑ All of the above

2. Small particles that live and replicate in a host and are the most common cause of food-borne illnesses:
   - ❑ Bacteria
   - ❑ Protozoa
   - ❑ Viruses

3. Important areas of potential contamination of fresh produce include:
   - ❑ Soil
   - ❑ Manure
   - ❑ Water
   - ❑ Workers
   - ❑ All of the above

4. Microbial pathogens can easily be removed from fresh vegetables by washing.. .....True or False

5. GAPs stands for:
   - ❑ Good Agricultural Pipedreams
   - ❑ Great Agricultural Practices
   - ❑ Good Agricultural Practices
   - ❑ Good Agronomic Practices

6. GAPs is required by law..... True or False
   - ❑ GAPs guidelines apply to:
   - ❑ Fresh produce
   - ❑ Processed fruits/vegetables

8. Accountability is an important aspect of GAPs implementation. .....True or False

9. What does GHP stand for?
   - ❑ Germicide Hygiene Plan
   - ❑ Good Hazard Plan
   - ❑ Good Handling Practices
   - ❑ Greater Hog Processors

10. What organism is *E. coli* considered?
   - ❑ A bacterium
   - ❑ A virus
   - ❑ A mycoplasm
   - ❑ A parasite

Module 1: Introduction to Fresh Produce Safety

Pre-Test/Post-Test Answers

1. What types of microorganisms have been most associated with outbreaks of food-borne illness attributed to produce?
   - ❑ Bacteria
   - ❑ Viruses
   - ❑ Parasites
   - ✓ **All of the above**

2. Small particles that live and replicate in a host and are the most common cause of food-borne illnesses:
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   - ❑ Protozoa
   - ✓ **Viruses**

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   - ❑ Manure
   - ❑ Water
   - ❑ Workers
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   - ❑ Good Agricultural Pipedreams
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