



Module 2: **GAPs Field Practices**

Acknowledgments

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Module 2: GAPs Field Practices

Estimated duration: 2 hours

Instructional overview:

Instructional objectives:

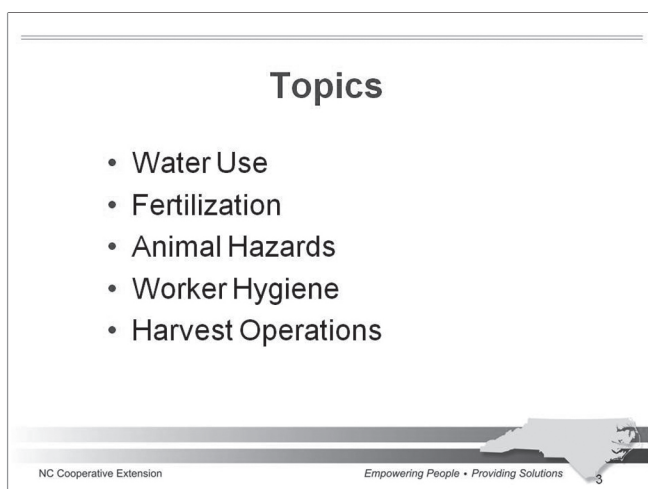
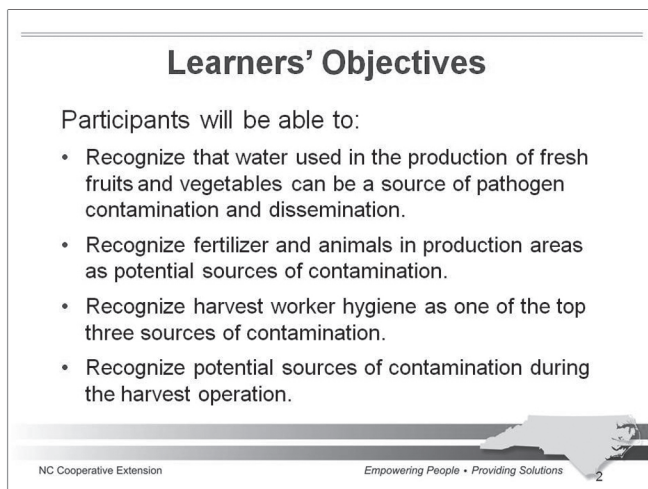
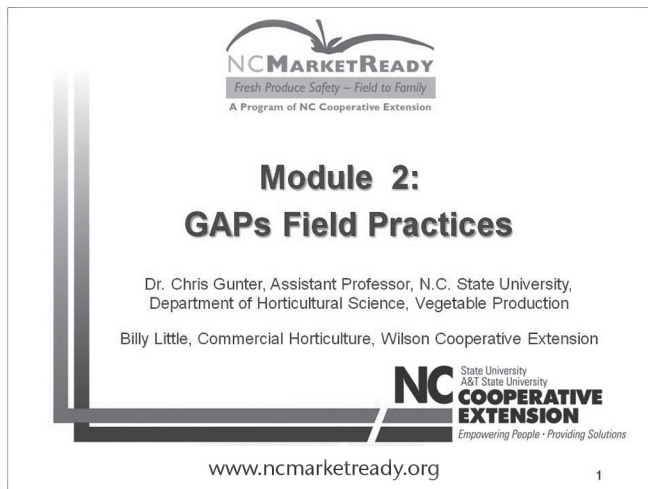
- Recognize that water used in the production of fresh fruits and vegetables can be a source of pathogen contamination and dissemination.
- Recognize fertilizer and animals in production areas as a potential source of contamination.
- Recognize harvest worker hygiene as one of the top three sources of contamination.
- Recognize potential sources of contamination during the harvest operation.

Equipment, supplies and materials needed:

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

Preparation needed:

- Review Module 2 and PPT prior to 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 PPT capability and an LCD projector. Save a copy of the presentation (from CD) on computer.
- Make copies of workshop activities, pre-test and post-test (if applicable) for all participants.
- Obtain easels, flip charts, markers if needed.
- Prepare room to accommodate participants and projector. Prepare sign-in sheet and nametags, as applicable.



Module 2

Welcome

Have participants make nametags and introduce themselves

PPT 2-1: Module 2: GAPs Field Practices Activity—Participant Pre-test

PPT 2-2: Learners' Objectives

No notes

PPT 2-3: Topics

No Notes

Water Use

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PPT 2-4: Water Use

No notes

Water Use

Learner Goal

Recognize that water used in the production of fresh fruits and vegetables can be a source of pathogen contamination and dissemination

Topics to Be Covered

- Surface water as a source of contamination
- Well water - pesticide residues
- Public water systems
- Irrigation practices - overhead versus drip/flood
- Water and livestock (runoff)
- Pesticide application
- Frost protection
- Testing (frequency) (See module 5)

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PPT 2-5: Water Use

No notes

FDA Guidance

Principle 4:

Whenever water comes in contact with produce, its quality dictates the potential for contamination. Minimize the potential of microbial contamination from water used with fresh fruits and vegetables.



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PPT 2-6: FDA Guidance

Water-quality management is perhaps the single most important issue in preventing food-borne diseases. The topic is covered in much detail in our workshop.

FDA Guidance

Water

- Agricultural water
 - Irrigation
 - Pesticide or nutrient sprays
- Processing water
 - Dump, wash, rinse, cool.
- Water quality management
 - Sanitation practices
 - Microbial testing



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PPT 2-7: FDA Guidance

Water may be inherently bad if contaminated at the source, and it may serve as a vehicle for spreading contamination as it is used for any specific purpose.

- We will discuss water-quality management in two distinct categories:
- Agricultural water used for irrigation, nutrient applications or pesticide mixes, and
- Process water used for
 - Dump, wash, rinse, cool
 - Water Quality Management
 - Sanitation practices
 - Microbial testing

PPT 2-7 (continued)

- Concerning agricultural water: There are three main sources of agricultural water. Usually, water for agricultural uses comes from:
 - Surface sources such as rivers, streams, irrigation ditches and canals and reservoirs
 - Ground water from wells (open or capped)
 - Public water systems such as those provided by towns or other municipalities

Agricultural waters can be readily contaminated by a variety of biological and chemical hazards, which include:

- Bacteria and viruses
- Domestic waste
- Nitrate nitrogen
- Synthetic organic chemicals
- Heavy metals
- Petroleum residues
- Combustion products from roadways

Sources of Contamination

#1 Source = Water

Anytime water comes in contact with fresh produce, its quality determines the potential for pathogen contamination since water may carry different types of microorganisms.

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Courtesy of FDA

PPT 2-8: Sources of Contamination

Water is an important source of contamination.

Irrigation Practices

- Surface water may contain pathogens and parasites of humans.
- Well (ground) water is less likely to harbor pathogens, depending on depth, but may contain pesticide residues or heavy metals.
- Water sources should be tested for generic *E. coli* and chemicals.

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PPT 2-9: Irrigation Practices

Make sure surface and ground waters are clean and usable for crop production and keep the test records!

Surface water may contain pathogens and parasites of humans.

Well (ground) water is less likely to harbor pathogens, depending on depth, but may contain pesticide residues or heavy metals.

Water sources should be tested for fecal coliforms and chemicals.

Irrigation Practices

- Overhead irrigation is more likely to spread contamination to above-ground plant parts than root-zone irrigation (furrow or drip).
- Consider proximity of water source to livestock (water runoff).
 - Maintain separation in distance and topography.
- Maintain records of safe irrigation practices.

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PPT 2-10: Irrigation Practices

1. You must consider these items when planning to irrigate your fields:

- Frost protection is typically overhead and you must consider water cleanliness.
- Ideally, this water should be of drinking water quality (potable).
- Prefer groundwater.

Management of frost protection water is similar to that of irrigation water, but must have more stringent control measures since this water is intended for direct fruit contact.

PPT 2-10 (continued)

2. Water used for pesticide mixing

- Should use potable water.
- Guatemalan raspberry-*Cyclospora* incident:

In 1996, California strawberries were implicated in an outbreak of *Cyclospora*. It was eventually discovered that raspberries from Guatemala were the culprit. The berries had been sprayed with a pesticide mixed in tainted water. Remember, despite popular belief, pesticides are not lethal to all life forms—most of them are specific to certain pests. This means parasites in water used to prepare fungicides will remain viable.

3. Ground water should be used exclusively and “ideally” treated or filtered for cleanliness before use, if at all practical.

Pathogens in Water

Water can be a source of and vehicle for biological hazards such as:

- *Escherichia coli*
- *Salmonella* spp.
- *Vibrio cholerae*
- *Shigella* spp.
- *Cryptosporidium parvum*
- *Giardia lamblia*
- *Cyclospora cayetanensis*
- *Toxoplasma gondii*
- Norwalk virus
- Hepatitis A.

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PPT 2-11: Pathogens in Water

Many human pathogens are readily transported in water.

Water Testing

- Research is needed relating to the quality and risks of field irrigation water.
- Fecal coliform is only partially useful as an indicator. Testing for generic *E. coli* is recommended.
- Remember that very low bacterial counts of *E. coli* O157:H7 will cause disease.

Courtesy of Cornell University

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PPT 2-12: Water Testing

Testing and quantifying irrigation water's microbiological condition are very important. Microbiological testing is used in the verification steps of a safety assurance program.

It is important to document the frequency and results of each water test for comparison purposes. These records would become very important in the event of a microbiological outbreak investigation.

PPT 2-12 (continued)

All agricultural water used to irrigate and wash fresh produce should be tested for the presence of generic *E. coli*. This is a special group of coliform (mentioned in PPT 2:9) that reside in the intestinal tract of warm-blooded animals. The notorious pathogen *E. coli* O157:H7 is a member of this group. High counts of fecal coliform indicate the water may have been contaminated with *E. coli* O157:H7 and/or other human pathogens. This water may be unsafe to use to irrigate crops or wash fresh produce. Based on risk assessment research, the recommended generic *E. coli* testing is as follows:

For water not coming in direct contact with the edible portion of a plant:

- Acceptance Criteria: Less than or equal to 126 MPN/100mL (geometric mean of 5 samples)
- Acceptance Criteria: Less than or equal to 576 MPN/100mL (for any single sample).

For water coming in direct contact with the edible portion of a plant:

- Acceptance Criteria: Less than or equal to 126 MPN/100mL (rolling geometric mean n=5)
- Acceptance Criteria: Less than or equal to 235 MPN/100mL (for any single sample)

Water used to wash produce must meet the U.S. Environmental Protection Agency's (EPA) goal for maximum contamination, or MCLG. The MCLG is the level of a contaminant in drinking water below which there is no known or expected risk to health. MCLGs allow for a margin of safety and are non-enforceable public health goals. MCLs (maximum contaminant levels) are enforceable standards. MCLs are set as close to MCLGs as feasible, using the best available treatment technology and taking cost into consideration. The MCLG for total coliforms in drinking water is zero.

Water Source Will Determine the Possible Frequency of Testing

Source	Possible Water Testing Frequency
Municipal/District water system	Test annually and keep records from the municipality/district water system (monthly, quarterly or annual report).
Closed system, under the ground or covered tank	One annual test at the beginning of season
Uncovered well, open canal, water reservoir, collection pond	Every month during the production season

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PPT 2-13: Water Source Will Determine the Frequency of Testing

The water used in agricultural activities must undergo microbiological testing, depending on its source. Tests should be taken at the source closest to the edible produce. The sources are listed in order of risk from low to high.

Protect Water

- Water destined for agricultural production can easily get contaminated with human and/or animal feces by direct or indirect routes.
- Keep animals and children out of fields and processing facilities and provide workers with properly constructed restrooms or sanitary mobile units.



Courtesy of FDA

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PPT 2-14: Protect Water

Water used in agricultural production can become contaminated in many ways. It is very important to think about potential direct and indirect routes and sources of contamination.

Fertilization

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PPT 2-15: Fertilization

No notes

Fertilization

Learner Goal

The learner will recognize fertilizer as a potential source of contamination.

Topics to Be Covered

- Organic versus inorganic
- Organic fertilizer handling (See Module 3)
- Chemigation as a source of contamination
- Application method

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PPT 2-16: Fertilization

No notes

FDA Guidance

Principle 5:

Practices using animal manure or municipal biosolid wastes should be managed closely to minimize the potential for microbial contamination of fresh produce.



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PPT 2-17: U.S. Food and Drug Administration (FDA) Guidance

This clearly has special importance for producers of organic products.

Fertilization Practices

- Inorganic fertilizers originate from synthetic chemicals, so pathogenic bacteria are not likely to be present.
- Incompletely composted manure may contain pathogenic bacteria.
 - Use only well-composted manure.
- Maintain records of safe fertilization practices.

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PPT 2-18: Fertilization Practices

Inorganic fertilizers are less likely to have pathogens than compost, but well-composted materials are also quite usable.

Proper Manure Management is a Key to Reducing Risks

Manure

- Water quality
- Worker and field sanitation
- Post-harvest handling
- Transportation



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PPT 2-19: Proper Manure Management Is a Key to Reducing Risks

Proper handling of manures and biosolids is crucial to a successful food safety program. The use of properly composted manures is preferred over the use of raw manure.

The use of manure is highly regulated when used on crops. (See Module 5 on fertilizer and composted manure for greater details.)

Pathogens Most Often Associated with Manure

- *E. coli* O157:H7
- *Salmonella*



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PPT 2-20: Pathogens Most Often Associated with Manure

Raw manures can be a source of contamination harboring a number of human pathogens, viruses and parasites. The two pathogenic organisms most commonly associated with food-borne illness outbreaks are *E. coli* and *Salmonella*.

Survival of Human Pathogens in Raw Manure

- Pathogens have been reported to survive in raw manure for one year or longer.
- No one knows precisely how long manure-borne pathogens survive after application to fields.
- Where it is not possible to maximize the time between application and harvest, raw manure should not be used.

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PPT 2-21: Survival of Human Pathogens in Raw Manure

If the use of manure cannot be managed to prevent contamination or at least reduce the level of contamination risk to a negligible level, do not use raw manure on a food crop.

Production Practices to Reduce Risks Related to Use of Raw Manure

- Use Best Management Practices (BMPs) to reduce contamination:
 - Proper storage
 - Incorporate
 - Target time of application
 - Target crop
 - Proper and thorough composting
 - Keep records

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PPT 2-22: Production Practices to Reduce Risks Related to Use of Raw Manure

Use management practices that prevent cross contamination or that properly compost raw manures. Keep records!

Animal Hazards

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PPT 2-23: Animal Hazards

No notes

Animal Hazards

Learner Goal

Recognize animals in production areas as a potential source of contamination.

Topics to Be Covered

- Animal feces in field as a source of contamination
- Animals spreading contamination from/to soil and water
- What pathogens animals carry
- Birds as a source of contamination
- Animal exclusion practices for the field—fencing, scare crows, cannons, water guns

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PPT 2-24: Animal Hazards

No notes

FDA Guidance

Principle 3:

Fresh produce can become microbiologically contaminated at any point along the farm-to-table food chain. The major source of microbial contamination with fresh produce is human or animal feces.



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PPT 2-25: FDA Guidance

Vigilance is required of every food handler from the field to the dinner table.

Animal Hazards

- Animal feces are a main source for pathogenic organisms.
- Since animals are in contact with soil, manure and water, they can easily pick up contaminants from these sources.
- Some pathogenic bacteria commonly found on animals include *Salmonella*, *Staphylococcus* and *Streptococcus*.
- Maintain records of pest control program.

Courtesy of FDA

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PPT 2-26: Animal Hazards

Animal waste is another important source of contamination.

Proximity of Animals



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PPT 2-27: Proximity of Animals

Keeping wild animals out of agricultural lands is not always practical or even possible.

Control Sources of Rodent and Bird Contamination



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PPT 2-28: Control Sources of Rodent and Bird Contamination

Good intentions (keeping produce shaded) sometimes have negative consequences. Birds in the trees may contaminate the fruit stored under the trees!

Cleaning Considerations for Surrounding Areas

- Keep grass and weeds short to avoid the presence of rats, reptiles and other pests.
- Keep all areas free of garbage.
- Remove all unnecessary equipment—old and broken equipment can provide protection for rats and insects.

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PPT 2-29: Cleaning Considerations for Surrounding Areas

All animals have the potential to cause contamination. Animals should be kept away from production and handling areas (agricultural fields, storage facilities, packaging areas, machinery, etc.), in order to prevent the contamination of fresh fruit and vegetables with biological hazards that can harm the consumer.

Keeping Animals Out

- Place rodent traps around the perimeter of buildings and monitor them daily.
- Electronic insect repellants or traps can be used inside buildings.
- Dead or trapped animals such as birds, insects, rats, etc. should be disposed of promptly to avoid attracting other animals. The proper disposal procedures are to bury or incinerate the animal.

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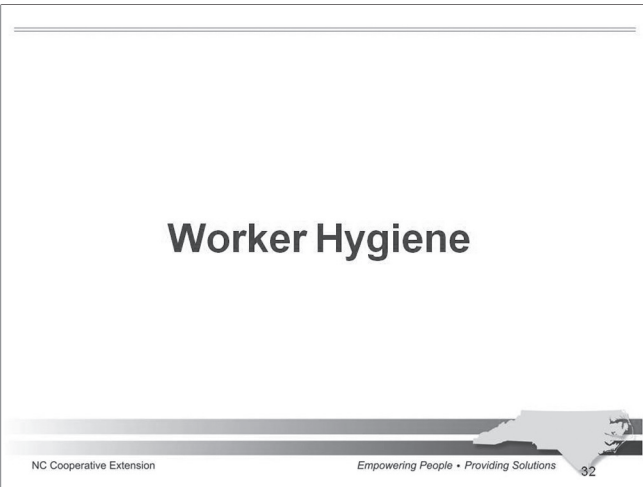
PPT 2-30: Keeping Animals Out

No notes



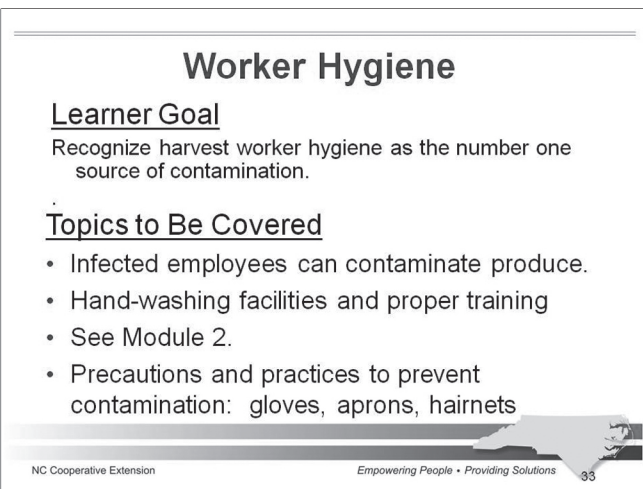
PPT 2-31: Rats with Wings?

No notes



PPT 2-32: Worker Hygiene

No notes



PPT 2-33: Worker Hygiene

No notes

Personal Health and Hygiene

- The major source of human pathogens are workers' hands, so the single most effective public health measure to prevent disease is *proper hand washing*.

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PPT 2-34: Personal Health and Hygiene

Proper hand washing before handling produce can be an effective disease prevention measure.

Employee Sanitary Facilities

- Number, condition and positioning of field toilets
- Should not be cleaned in field
- Hand-washing stations readily available

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PPT 2-35: Employee Sanitary Facilities

Sanitary facilities in the field are better known as "port-a-johns." Federal law states there should be one "port-a-john" and hand-washing station for every 20 field workers, and the sanitary facilities should be stationed no farther than one-quarter mile from the work activities and workers. Facilities need to be easily accessible for cleaning. A response plan needs to be in place in the event of a major spill or leak. Check with the service provider to determine if they have a spill or leak response plan in place. Records of cleaning and servicing should be maintained.

Tomato Harvest



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PPT 2-36: Tomato Harvest

No notes

What's Wrong?



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PPT 2-37: What's Wrong?

So what's wrong in this picture?

Produce is too close to the facility. There is no visible hand-washing station (maybe inside the facility). What about the portability of this unit? Is it near the field?

What Else Is Wrong?



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PPT 2-38: What Else Is Wrong?

Also, notice drainage water near the basket.

Good Example



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PPT 2-39: Good Example

No notes

Toilet Paper in the Woods



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PPT 2-40: Toilet Paper in the Woods

Workers will take the easy route in taking care of business. Then how are they to wash their hands?

Sanitary Facilities Disposal

- Use caution when servicing portable toilets; do not dispose of sewage in the field.
- Plan for the containment and treatment of any effluent in the event of a leak.

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PPT 2-41: Sanitary Facilities Disposal

Growers should never empty sewage from “port-a-johns” directly onto a field. Some pathogenic bacteria and viruses can survive for up to a year in fertile topsoil.

What's Wrong?



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PPT 2-42: What's Wrong?

Although these packing-house workers are wearing gloves, another hazard is present. The plastic or glass dial face of the wristwatch can easily loosen or be broken and fall into the processing line.

Activity: Break into small groups to identify problems in photos. Then show photos on screen of PPT 42, PPT 43, PPT 44, PPT 45. Have participants analyze what is wrong or what is the problem area in each picture. Have each person in the group write down how they would address the problem issue.

Break Time!



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PPT 2-43: Break Time!

Here is what some workers do with their gloves when it's time for a break.

Mmmm – Tastes Good!



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PPT 2-44 : Mmmm—Tastes Good!

Good Management Practices (GMPs) dictate that workers should never be allowed to eat, smoke or drink while working on a grading belt.

Good Intentions



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PPT 2-45: Good Intentions

Here is an employee using good personal hygiene, but look where he has placed his gloves!

Proper Hand-washing Is the Best Method of Reducing Contamination



Probably the #1 source of food-borne illness is unsanitary worker conditions.

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PPT 2-46: Proper Hand-Washing Is the Best Method of Reducing Contamination

No notes

Workers Showing Symptoms or Injury

- Supervisors should put workers showing symptoms of illness on tasks that do not involve direct contact with produce.
- Workers with injuries that may come in contact with produce should be given tasks not involving direct contact with produce.
- Employees should be encouraged to report illness and injury to their supervisors.

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PPT 2-47: Workers Showing Symptoms or Injury

No notes

Harvest Operations

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PPT 2-48: Harvest Operations

No notes

Harvest Operations

Learner Goal

Recognize potential sources of contamination during the harvest operation.

Topics to Be Covered

- Soil contact with produce, totes, bins, boxes, workers hands, harvesters
- Mechanical injury/damage by workers, equipment
- Do not field wash produce; do not pre-cool using nonpotable water
- Avoid animal contamination following harvest
- Sanitizing totes, harvest equipment, etc.
- Packing container storage: clean, dry place not in fields
- Field identification system for produce containers (traceback)

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PPT 2-49: Harvest Operations

No notes

Field Work

- Harvest Containers
- Field Equipment
- Field Packing
- Bins



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PPT 2-50: Field Work

Field sanitation is a critical step in GAPs implementation. Field packing has its own special requirements since the product may go directly from the field to the consumer in the same package. Buyers or third-party certifiers may have specific recommendations.

Proper cleaning and handling of bins or other harvest containers is essential. Assure that cross contamination between animal and produce operations does not occur.

- Bins and Harvest Containers
- Field Equipment
- Field Packing
- Bins

Field Harvesting



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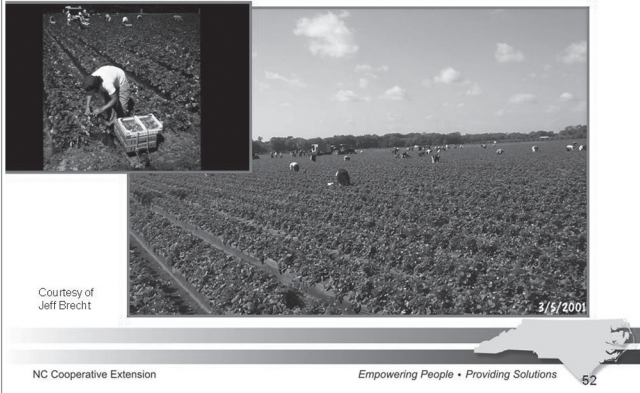
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PPT 2-51: Field Harvesting

There are many opportunities for fresh produce to be contaminated by human contact. Here are a few of them.

Strawberry Harvest Cart



PPT 2-52: Strawberry Harvest Cart

And more examples.

Recognize and Eliminate Sources of Contamination

- In the field
- At harvest
- In the packinghouse
- In refrigerated storage rooms

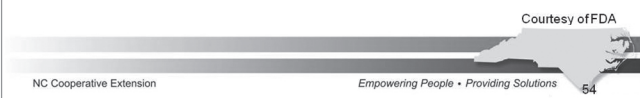


PPT 2-53: Recognize and Eliminate Sources of Contamination

Follow these steps.

Field Hazards

- Field Hazards include contact with:
 - Soil
 - Fertilizers
 - Water
 - Workers
 - Harvesting Equipment
 - Animals, birds and insects.



PPT 2-54: Field Hazards

Field hazards are important concerns.

Harvest Sanitation

- Avoid contact between fruits, vegetables, bins, etc. and soil.
- Avoid bruises or cuts to fruits or vegetables that may allow internal contamination.
- Don't use open-water sources for field washing.
- Provide restrooms and hand-washing stations.
- Clean and sanitize bins and harvest equipment after each use.

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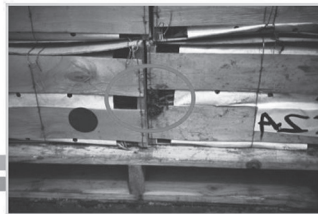
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Field Conditions May Increase Risks



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PPT 2-55: Harvest Sanitation

Harvest time is a critical time in crop sanitation.

PPT 2-56: Field Conditions May Increase Risks

Soil carried from the field on containers becomes a source of contamination in the packing house. Clean and sanitize (disinfect) harvest containers and harvesting implements prior to use. Equipment should be in good repair. Light bulbs and glass on harvest equipment are protected against breakage and contamination of produce.

Summary

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PPT 2-57: Summary

No notes

Activity: Post Test

Resources

- Guide to Minimize Microbial Food Safety Hazards for Fresh Fruit and Vegetables, USDA 1998.
- 2002 NCSU-Series of Good Agricultural Practices for the Production and Handling of: Guides.
- Commodity Specific Food Safety Guidelines for the Production and Harvest of Lettuce and Leafy Greens, May 24, 2007.
- USDA Good Agricultural Practices and Good Handling Practices.
- Audit Verification Checklist, USDA.
- Chlorine Use In Produce Packing Lines, University of Florida IREC 1999-9.
- Testing/Monitoring/Sanitation Equipment and Supplies, Fresh Produce GAPs/GMPs Workshop UGA 2004.
- Fresh Produce Food Safety Training Program for the Southeast, University of Florida, 2001.

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PPT 2-58: Resources

No notes

This project received funding from the N.C. Tobacco Trust Fund Commission, Sustainable Agriculture Research & Education (SARE) and Risk Management Agency.



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Pre-Test/Post-Test

ID Number/Name: _____ Date: _____

1. Land-use history plays a major role in the potential for produce contamination. True or False
2. Well water is less likely to contain pathogens depending on depth.. True or False
3. Overhead irrigation is more likely to spread contamination to plant parts than root zone irrigation..... True or False
4. Water used in the field for uses other than irrigation, for example frost protection or pesticide application, can be a source of contamination. True or False
5. Raw or uncomposted manure can be used during the growing season.. True or False
6. Composted manure can be recontaminated by birds, rodents, animals and wind or water contaminants.. True or False
7. The farm owners' dog is allowed in production fields, when accompanied by the farmer..... True or False
8. The hygiene of harvest workers plays no role in contaminating fresh produce..... True or False
9. Soil contact with produce bins can be a source of contamination.. True or False
10. Pests and rodents in the packing facility may contaminate produce during grading or storage..... True or False

Module 2: GAPs Field Practices

Pre Test/ Post Test Answers

1. Land-use history plays a major role in the potential for produce contamination. **True** or False
2. Well water is less likely to contain pathogens depending on depth.. **True** or False
3. Overhead irrigation is more likely to spread contamination to plant parts than root zone irrigation..... **True** or False
4. Water used in the field for uses other than irrigation, for example frost protection or pesticide application, can be a source of contamination. **True** or False
5. Raw or uncomposted manure can be used during the growing season..... True or **False**
6. Composted manure can be recontaminated by birds, rodents, animals and wind or water contaminants.. **True** or False
7. The farm owners' dog is allowed in production fields, when accompanied by the farmer..... True or **False**
8. The hygiene of harvest workers plays no role in contaminating fresh produce..... True or **False**
9. Soil contact with produce bins can be a source of contamination.. **True** or False
10. Pests and rodents in the packing facility may contaminate produce during grading or storage..... **True** or False

Module 2: GAPs Field Practices

Activity – ID Problems

(Time: 10 minutes)

1. Break into small groups to ID problems in a photo. Then show photo on screen (slide #37).
2. Have participants analyze wrong is wrong or what the problem area is.

(Example: Display photo of produce field downslope from a cow pasture. Have each person in group write down how they would address the issue if they see a problem. Share results within group and with other groups.)