Good Agricultural Practices

Reduce Risks of Microbial Contamination During Production
The Produce ‘Outbreak’ Chain Reaction

- Consumers become ill.
- Consumers lose confidence in safety of food.
- People eat less produce, decreasing sales.
- Works against “5-A-Day” nutrition programs.
- Leads to unwanted legislation or regulation.
Modified from Beuchat, 1996
Humans

Produce

Animals

Feces

Modified from Beuchat, 1996
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Humans

Produce

meat, milk, eggs

(cross contamination)

Animals

Feed

soil

water

Feces

Insects

harvesting, handling, processing environments
Naturally Occurring Bacteria

E. coli

Salmonella
Good Agricultural Practices Can Reduce Food Safety Risks

- Good Agricultural Practices (GAPs) for food safety include Best Management Practices (BMPs) to protect the environment.
- These same practices that reduce losses of soil and nutrients can reduce risk of microbial contamination of produce.
- Keeping records of production practices allows regular updates of plans.
Reduce Plant Diseases

• Many bacteria behave the same in the environment.
  - *E. coli* / *Salmonella* vs. Bacterial Leaf Spot / decay

• Many BMPs that decrease plant pathogens also decrease human pathogens.
Reduce Post Harvest Loss

- Post-harvest management practices that reduce loss to spoilage or shrinkage will reduce risks.
- These include sorting, quick cooling, chlorinated wash water, and good refrigerated storage and shipping.
Review Field Management Practices to Reduce Risks

- Manure
- Crop Selection and Management
- Water quality
- On-Farm Planning and Documentation
Manure = Fecal Matter = Microbes

- Human or animal: DO EVERYTHING you can to keep manure off produce.
- Preventing contamination is the goal.
All Manure Can Carry Pathogens

- **Livestock**
  - cattle, swine, poultry, horse, & sheep
- **Dog and Cat**
- **Bird**
- **Rodent**
- **Deer**
- **Fly or other insect**
- **Human**
E. coli 0157:H7 Sources

- Water
- Manure of young or transitioning livestock (feed or housing)
  - 5% of post wean heifers shed E. coli 0157:H7
  - 2% calves
  - 1% adults cows
- Manure of other animals
E. coli 0157:H7 Has a Seasonal Pattern

- Most prolific under warm humid conditions.
- Frequently traced back to moist animal feed and water troughs.
**E.coli and Other Bacteria are Vulnerable to Competition**

- In soils, *E. coli* O157:H7 levels decrease over time due to natural conditions.
- Incorporation reduces physical transmission risk (splash) and increases competition.
- High temperature, aerobic composting of manure reduces levels quickly.
Plan Herd Health and Manure Management

• Use environmentally sound manure treatments, applications, and disposal.

• Work with veterinarians to create biosecurity plans.
  – feeding programs
  – animal isolation
On-Farm Manure Handling

- Manure
  - Store for 6 months prior to field application.
  - Compost manure correctly.
- Slurry storage systems and waiting periods
  - Wait 60 days in summer and 90 days in winter prior to spreading.
  - Consider satellite storage or special management for slurry destined for vegetable ground.
Salmonella survives for long periods under conditions common on the livestock farm

Pasture and soil ---- 200 days
Garden soil ---- 251 days
Liquid manure --- 27 days ( S. Dublin), --- 286 days ( S. Anatum)
Slurry - 84 to 250 days
Infected feces stored in cans - 159 days ( S. Dublin)
Compost Manure Properly

• Manage piles to have active, uniform composting.
  • High temperatures, good moisture, proper aeration, and mixing.
  • Weed seeds killed means good composting conditions were achieved.
• Exclude animals from compost area to prevent recontamination.
Composting Research

- Larney et al. (2003) reported that more than 99.9% of E. coli was eliminated in the first 7 days of windrow composting with temperatures ranging from 33.5 to 41.5 °C (92 to 107°F).
- Johannessen et al. (2005) demonstrated that composting animal manure for 40 days during which a temperature of >60 °C (140 °F) is maintained for at least 5 days is effective at removing E. coli.
Recommendations for Composting

- Carbon source and aeration method don’t seem to make a difference, but composting in windrows is more effective than in enclosed vessels.
- Be sure to compost in such a way that the compost reaches 130-140°F for two 5-day cycles.

Dr. Jessica Davis, Colorado State University
Manure Application

- Do not assume any manure is ‘clean’.
- **Incorporate, Incorporate, Incorporate**
- Absolutely NO SIDEDRESSING with fresh manure.
- Know manure source and handling.
Time manure applications WISELY

• Following recommendations to minimize negative environmental impacts.
  - Timing of manure spreading now regulated in Maine and Vermont.

• In the fall, apply to cover crop.

• In the spring, incorporate two weeks prior to planting.
Target manure applications

WISELY

- If applying manure in spring, target agronomic crops (grain) or new perennial plantings (apple or strawberry).
  - Crops not targeted for direct human consumption
  - Delayed harvest reduces risk (perennials)
Observe Pre-Harvest Intervals for Manure

If applying manure in spring to fruit and vegetable fields, wait 120 days to harvest.

• Not all pathogens die at the same rate
Keep Records of Manure and Compost Use

- Know your source of manure or compost.
- Know the methods used to produce compost or the manure storage time.
- Keep records of application rates, timing, and fields receiving manure or compost.
Crops for Manured Fields

• Avoid root/low growing crops (lettuce, beets) in season manure is applied.
• Avoid crops consumed fresh or those where leaves are eaten by humans.
• Apply manure to ground where perennials are being planted.
Crop Management

- Use trellis/staking where appropriate, such as tomatoes.
- Use plastic mulch and drip irrigation to reduce leaf wetting.
- Use organic mulches to reduce splash.
Exclude Animals

• Keep wildlife out of production areas as much as possible.

• Manage rodents and birds in packing houses and storage areas.

• No weeder geese in fields prior to harvest.

• No dogs or other pets in the field.
Water Carries Pathogens

• *E. coli* 0157:H7 viewed primarily as a water-borne pathogen.
  – Many outbreaks associated with recreational water.

• *Salmonella, Giardia* and *Cyclospora* outbreaks on produce caused by contaminated water.
Water Management

- Select water source based upon agricultural use.
- Clean water quality is most important when in direct contact with edible portion of crop close to or at harvest.
Water Management

• Choose application method and treatment to reduce risk
  • Drip has a lower risk than overhead irrigation
  • Chlorinate dump tanks and wash water
• Keep records of water tests
Know Water Source Quality

• Best source (lowest risk) is drinking water, such as municipal.

• Ground water is less likely to have microbial contaminants than surface water.

• Surface water quality and pathogen levels are affected by watershed activities and season.
Surface Water Contamination Sources

- Livestock
- Sewage treatment facilities
- Wildlife
Well Water Contamination Sources

- Poorly maintained wells or pumps
- Livestock in active well recharge area
Drip irrigation maximizes water use efficiency (WUE) and keeps leaves dry.

- WUE is yield per volume water added as irrigation

- If applying overhead, apply early in the morning to conserve water.
  - Speeds leaf drying time
  - Reduce crop diseases
Irrigation Water
Microbial BMPs

• Drip Irrigation has lowest risk
• Overhead irrigation
  – Source determines risk
  – Apply to minimize leaf drying time
  – Longer periods between overhead irrigation and harvest lowers risk
Spray Water Quality

• Use potable (drinking) water for pesticide sprays.

• When potable water is not available, test water quality and keep records.

• Low water volumes reduce risk.
Water Testing

• Research relating to field irrigation water quality and risks is still needed.
  – Fecal coliform count < than 100 per 100 mls is one recommendation
  – Survival on produce surfaces is variable
• Fecal coliform as an indicator of water quality only partially useful.
  – Not always correlated to pathogens
  – Does suggest general contamination
For Idaho - 576 *E. coli* organisms/100 ml of sample or less

A policy statement should be included in your SOP outlining the step(s) that will be taken if *E. coli* levels exceed this threshold.
Water Testing Frequency

- Annually with municipal water
- Quarterly with groundwater
- Test surface water for quality assurance
  - 3 times during season in temperate climates
    - at planting (high flow)
    - at peak use (low flow)
    - at harvest
  - Quarterly in more southern climates
- Maintain good records of results
What Can You Do?

- Learn about the risks.
- Develop a plan.
- Document your actions.
- Strive to reduce risks.
On Farm Food Safety Plan: Where to Begin?
Farm Food Safety Plan
Describes:

• Manure storage and handling
• Animal exclusion (domestic & wild)
• Irrigation and drainage management
• Equipment sanitation
• Harvest and post harvest handling
• Employee training program
• Restroom & hand washing facilities
• Crisis management strategy
Start with What You Know!

- Assess your operation, pre-plant through post-harvest handling.
- Identify areas that you know are high risk or areas of concern.
- Consider farming practice modifications that will reduce the risks AND are economically feasible.
- Document your progress.
Be Active and Be Ready

• Make changes to practices as needed.
• Keep good records of all production practices, especially manure use and water tests.
• Teach employees the importance of prevention strategies.
• Work with upstream neighbors and local watershed committees on management goals.
• Update your plan regularly.
Good Agricultural Practices for Managing Food Safety Risks Continue to Evolve

As new research becomes available, recommended practices may change.
GAP Audit and Marketing

• Direct marketing (eg. Farmers’ Markets)
  – Not required yet
  – Customer/Consumer request
  – Discussion continues
  – All should have a farm/food safety program in place regardless of audit
  – Have working knowledge of GAP requirements
  – Look over GAP audit- improvements to farm program
  – Advantage: Market to customers you are GAP certified?
“E. coli O157:H7 attributed to Oregon strawberries sold at farmers markets and roadside stands. At least 15 illnesses and one death were likely caused by the strawberries, which possibly were contaminated by deer feces in the field.”
Regardless if have a formal audit or not, you should have a food safety program on farm

- Resources available
  - FamilyFarmed.org – “Create Customized Food Safety Plans for Free” – Prepares you for an audit
  - Knowledge of your high risk areas
  - Prepared for customer request(s)
Food Safety Program or GAP Audit

- Develop Food Safety Plan (Protocols)
- Two critical components
  - Education of employees
  - Documentation of practices
What is the USDA GAP Audit?

- Series of questions to ensure a food safety program was developed and utilized for the farm
- Some questions require records, documentation, policy statements or yes/no/not applicable answers.
- Need a farm tailored standard operating procedure (SOP)
USDA GAP and GHP Audit for Fruit and Vegetable Programs
Released: May 11, 2007
Revised: November 9, 2009
Revised June 2011
USDA GAP Audit

- Universal for all fresh fruits and vegetables
- Commodity specific standards and audits complete for tomatoes, mushrooms and leafy greens
- FDA specific guidance documents for leafy greens, melons, tomatoes, fresh cut fruits and vegetables
GAP Resources

USDA: Fresh Product Grading and Quality Certification and the User’s Guide:  
www.ams.usda.gov/fv/fpbapghp.htm

ISDA FFV Food Safety Program:  
www.idahoag.us/Categories/InspectionsExams/FoodSafety/indexfoodSafetyHome.php

GAP Network for Education and Training Cornell University: www.gaps.cornell.edu

University of Idaho GAP Audit Manual for potatoes:  
www.kimberly.uidaho.edu/potatoes/gap.htm
Discussion

Food Safety Begins on the Farm
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