Module 3: Soil Amendments
Learning Objectives

• Identify potential routes of contamination associated with soil amendments
• Explain soil amendment handling practices that may reduce risks
• Identify key strategies such as composting or application intervals to reduce risks
• Describe corrective actions that may be utilized if a soil amendment presents a risk
• Identify recordkeeping tools for monitoring and managing soil amendment handling, application, and proper use
What Is A Soil Amendment?

- Soil amendments are any chemical, biological, or physical materials intentionally added to the soil to improve and support plant growth and development.
- May reduce soil erosion and sediment runoff.
- Many different types of soil amendments are available.
- Soil amendments can present produce safety risks.
- Assessing risks and implementing GAPs can reduce risks.
Soil Amendments & Food Safety Risks

• Biological soil amendments, especially those that include untreated (raw) manure, pose significant microbial risks
• Synthetic (chemical) soil amendments can also impact food safety, if not prepared and applied properly
• Risks should be assessed when selecting and applying all soil amendments on produce fields
Assessing Your Risks

• What type of soil amendments do you use?
  – Raw manure, composted manure, chemical, etc.

• What crops receive soil amendments?
  – Fresh produce or agronomic crops

• When do you apply them?
  – Days to harvest, time of year

• How do you apply them?
  – Incorporated, injected, surface applied

• How much and how often do you apply them?
  – Excessive application can lead to environmental impacts
Chemical Soil Amendments

- Minimal risk of human pathogens
  - Cannot be considered 100% safe
  - Synthetic fertilizers, minerals
- Can pose chemical risk to humans
  - Be sure workers are trained to apply properly and use personal protective equipment
  - Follow all application instructions
  - Proper labeling and storage
Human Waste & Biosolids

• Human waste is prohibited for use on produce crops, unless it meets the EPA regulation for biosolids (40 CFR part 503)

• Untreated human waste may contain pathogens, heavy metals, or other contaminants

• May not be accepted by produce buyers

• Management of biosolids not discussed because use is infrequent in fresh produce production
Pre-Consumer Vegetative Waste

• Should not be considered zero risk and may contain:
  – Chemical hazards
  – Physical hazards
  – Biological hazards

• Examples include:
  – Produce food preparation waste
  – Out of date vegetables
  – Food products removed from their packaging
Non-Manure Based Soil Amendments of Animal Origin

• Should be processed to eliminate pathogens or must be considered untreated biological soil amendments of animal origin.

- Bone meal
- Blood meal
- Feather meal
- Fish emulsion
The Value of Manure

- Increases soil tilth, fertility, and water holding capacity
- Sound nutrient management and waste utilization for those with animal production or partnering with other farms who have animals
- Widely available and cost effective
Pathogens in Animal Manure

- All manures can carry human pathogens
- Some animals tend to be reservoirs for certain pathogens
- Many things can affect animals shedding pathogens in their manure
  - Age
  - Rearing practices
  - Diet
  - Season
  - Environmental conditions
Untreated Soil Amendments

• Untreated biological soil amendments of animal origin are considered high risk since they have not been treated to reduce or eliminate pathogens

• All of the following soil amendments would be considered untreated:
  – Raw manure
  – ‘Aged’ or ‘stacked’ manure
  – Untreated manure slurries
  – Untreated manure teas
  – Agricultural teas with supplemental microbial nutrients
  – Any soil amendment mixed with raw manure
Reducing Soil Amendment Risks

- Selection
- Treatment
- Application Timing

- Application Methods
- Handling and Storage
- Recordkeeping
Composting as a Treatment

• Composting is a **controlled** biological process that decomposes organic matter and reduces pathogens
• Temperature is the primary method of pathogen reduction for thermophilic composting; however, chemical and biological factors also contribute
• Only a composting process that has been scientifically validated ensures pathogen reduction
• Process monitoring and recordkeeping are critical to ensuring the compost is adequately treated
Properly Composted Manure

- High temperatures are maintained by;
  - Manipulating the compost pile inputs (feed stocks)
  - Proper carbon to nitrogen ratios
    - Initial C:N ration of between 25:1 and 40:1
  - Moisture percentage
  - Aeration
Going the Extra Step

- Cure compost
  - Leave finished compost in an undisturbed pile for at least 2 months.
- Remember
  - Keep curing or finished compost away from ‘active’ compost piles.

**Best practice: store, cover or apply finished compost immediately following curing stage.**
Composted Manure  
(lower risk)

- Substantially reduces microbial pathogens
- Finished product will yield a valuable soil amendment, with few pathogens, if composted properly.

Safety Considerations
- Compost temperature not monitored
- Failure to properly turn compost pile
- Finished compost contaminated by nearby manure piles
- Curing finished compost
Composting Options

Must use a scientifically valid process:

1. Aerated static composting: aerobic, minimum 131°F (55°C) for 3 days, followed by curing with proper management to ensure elevated temperatures throughout all materials

2. Turned composting: aerobic, minimum of 131°F (55°C) for 15 days, minimum 5 turnings, followed by curing

3. Other scientifically valid, controlled composting processes
Properly Composting Manure

- Two popular methods
  1. In-vessel or static aerated pile system
     - Temperatures must be maintained of at least 131 °F for 3 days
Properly Composting Manure

2. Windrow composting system
   - Temperatures must be maintained of at least 131 °F for 15 days, during which time, the materials must be turned a minimum of five times.
Properly Composting Manure
Reducing Risks During Application

Steps you should take to reduce risks:

• Preferentially apply soil amendments containing manure to crops not intended for fresh consumption
• Maximize the time between application and harvest
• Do not contact the edible portion of the crop during application.
• Do not side-dress with raw manure
• Minimize risks to adjacent produce crops if you are field spreading manure
Minimum Application Intervals

• There are currently no application intervals for raw manure outlined in the FSMA Produce Safety Rule

• Untreated Soil Amendments
  – FDA is currently pursuing further research to support application intervals for raw manure
  – Raw manure must not be directly applied to the harvestable portion of the crop

• Treated Soil Amendments
  – Zero day application interval for compost treated by a scientifically validated process
PSR vs RI GAP

- NOP recommended vs required
Fresh or Raw Manure

- **Application Recommendations - NOP**
  - Incorporate into the soil (after harvest period) before the ground freezes
  - OR
  - Incorporate into the soil
    - 120 days prior to harvest of product whose edible portion in direct soil contact OR
    - 90 days prior to harvest of product whose edible portion does **NOT** have direct soil contact

* Avoid growing root and leafy crops in the year that manure is applied to a field
Handling Recommendations

• Designate specific equipment and tools for handling soil amendments
• Develop SOPs to clean and sanitize equipment and tools that contact soil amendments and fresh produce
• Direct traffic (foot, equipment) around soil amendment storage or processing areas to reduce the risk of cross-contamination
Storage Area Recommendations

• Minimize runoff, leaching, and wind drift to reduce contamination of crops, water sources, and handling areas by soil amendments
  - Cover piles
  - Build berms to prevent runoff

• Do not store in locations that are likely to experience runoff or areas that are close to water sources

• Keep raw manure and finished compost in separate areas to prevent cross-contamination

• Minimize animal access to compost piles
Workers who handle soil amendments, both treated and untreated, should:

- Understand SOPs for properly completing tasks which require managing raw manure or compost
- Make sure clothes, boots, and gloves are clean before handling produce
- Wash hands after handling
Soil amendments can introduce microbial risks, so you should document:

- Type and source of soil amendment
- Rates and dates of application
- Handling and sanitation practices used that reduce risks

There are a few records required for treated biological soil amendments of animal origin within the Produce Safety Rule
- Some details are outlined on the next few slides
Recordkeeping: On-Farm Composting

Key factors in the composting process must be documented. These may include the following steps depending on the process used:

– Time
– Temperatures
– Turnings
– Other processing steps
Recordkeeping: Soil Amendments Supplied by a Third Party

Documentation should be kept of:

- The name and address of the supplier
- What soil amendments were purchased
- The date and amount purchased
- Lot information, if available

Documentation must be collected from the supplier:

- To ensure the supplier has used scientifically validated treatment processes and monitoring during the production of the treated amendment (including compost)
- To ensure proper handling requirements have been met
Corrective Action Plan

• Outline steps that could be taken if soil amendments:
  – Pose a microbial risk to the crop
  – Were improperly treated
  – Accidentally contacted the edible portion of the crop

• Think of alternative market options
  – Processing markets that involve a “kill” step

• Document in your plan
Summary

• Soil amendments can introduce produce safety risks, especially those that contain raw manure

• To reduce risks associated with soil amendments:
  1. Apply untreated manure to non-produce fields
  2. Treat raw manure using a scientifically validated, controlled process
  3. Extend the time between application of raw manure and harvest

• Make sure storage areas do not contaminate fields, water sources, or packing areas

• Train workers who handle and apply soil amendments

• Develop sanitation steps for tools and equipment

• Keep records of soil amendment applications and treatments