Why focus on E. coli?

- E. coli stands out for its
  - Low infectious dose
  - Survival under adverse conditions (freezing, drying, acidic pHs)
  - Extreme disease severity
Is all E. coli O157:H7?

• This particular strain of E. coli progresses quickly with severe consequences (especially in children and the elderly)
  - Causes hemorrhagic colitis (bloody diarrhea and severe abdominal pain)
  - Can cause hemolytic uremic syndrome (lack of urine formation, renal failure)
    • 50% require dialysis
    • 15% have chronic kidney failure
    • 3-5% die
How does E. coli get in our food?

- E. coli can be transferred to food through several pathways
  - Contamination of meat with fecal material during slaughter
  - Contamination of crops through manure utilization
  - Runoff or shedding into surface water or leaching into groundwater
Questions for Today

1) Are there management practices we can use while composting to kill E. coli and minimize its transmission to food?

2) Are there management practices we can use when using manure or compost in crop production to minimize infection?
Effect of Carbon Source

• Larney et al. (2003) evaluated the effect of bedding type on E. coli populations in cattle manure compost.
  – Barley straw or wood chips
• They concluded that bedding type did not influence E. coli reduction during the composting process.
Aeration Method

• Velasco-Velasco et al. (2004) composted manure and oat straw and compared forced aeration (actively aerated static piles) with manual aeration (turned piles).
  - Forced aeration reduced E. coli population by 99.9% after 60 days.
  - Manual aeration reduced E. coli population by 100% after 60 days.
  - There was no significant difference.
In-Vessel vs. Windrow Composting

• Cekmecelioglu et al. (2005a) compared in-vessel composting with windrow composting.
  - They concluded that reductions in E. coli populations were greater in windrows than in enclosed vessels due to higher temperatures maintained over a longer period of time and extended processing time.
  - They also compared two windrow building methods (with a manure spreader and with a vertical auger), but reported no difference in these methods.
Effect of Temperature: Lab Studies

• In a laboratory study seeded with E. coli, Lemunier et al. (2005) found that E. coli survived for only 4 weeks at 25°C (77°F) in a 3-month study.

• Lung et al. (2001) evaluated manure composting in a bench-scale system.
  – E. coli was not detected after 72 hours of composting at 45°C (113°F).
  – BUT there was no reduction in E. coli population at room temperature (77°F).
Effect of Temperature: Lab Studies

- Jiang et al. (2003) composted manure and other feedstocks in lab-scale bioreactors at two different temperatures: 21°C (70°F) and 50°C (154°F).
  - E. coli populations went up during the first 24 hours of composting and then decreased over the next 36 days.
  - At 70°F, large populations of E. coli survived for 36 days.
  - At 154°F, E. coli was undetectable after 7-14 days.
Effect of Temperature: Field Studies

• 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.
Effect of Season

• In a study of windrow composting of food waste mixed with manure, Cekmecelioglu et al. (2005b) reported seasonal differences on peak temperatures, duration of high temperature, and survival of E. coli.
  - Starting population=377-483 MPN/ g
  - After 150 days in winter=6-140 MPN/ g
  - After 150 days in summer=<0.3 MPN/ g
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.
Recommendations for Manure Use

- Never spread raw manure on growing food crops.
  - The risk is higher for leafy crops, root crops, other crops with direct contact between the edible portion of the crop and the soil.
- Do not apply uncomposted manure to crops which humans eat raw.
Recommendations for Manure Use

• Don’t leave manure on the soil surface. Incorporate it prior to planting.

• Apply manure (and incorporate it) 120 days prior to harvest of a food crop.
Recommendations for Compost Use

• Use compost instead of manure to minimize risk.