Planning for Postharvest Food Safety During On-Farm Production

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Raw animal manure, manure slurries or "teas," animal manure-based composts, and composted sewage biosolids are applied during preplant operations or during in-season growth to a diversity of edible crops. In response to the uncertainties surrounding the increased frequency of outbreaks of foodborne pathogens, serious concern has been raised for the potential transfer of microbial pathogens to produce from these sources. Researchers at the University of California, Davis, and other academic, government, and private institutions are beginning to address the key information needs in understanding the environmental persistence and control points for these pathogens of global concern. Preventive measures for postharvest food safety will depend upon:

- animal health management
- proper compost process control
- and appropriate preplant intervals for raw manure.

Our objective as researchers is to obtain baseline and directional information to identify where data gaps exist and could be addressed in future near-term research. Immediate-term information is needed to guide growers, Cooperative Extension personnel, the diagnostic service industry, shippers, and processors in the development of on-the-farm management practices to prevent microbial pathogens from being introduced during production and persisting in soil or on the crop at harvest. Areas we are beginning to address include:

1. Information on sources and persistence;
2. Manure compost process control;
3. Timing of incorporation relative to crop seeding and harvest;
4. Depth of incorporation into soil to minimize persistence;
5. Potential for establishment on plant parts during production; and
6. Postharvest prevention programs.

EPA Regulations

Regulatory oversight of the use of raw manure, composted manure, and biosolids is highly variable in the United States. The Environmental Protection Agency (EPA) regulations require that typical windrow-aerobic composting process will maintain a core temperature of 55°C (131°F) for 15 days. A minimum of five thorough inversions of the pile are required to achieve the desired fecal coliform count reduction. These process steps, therefore, become key components of the documentation and record-keeping that will be expected to assure that good management practices are being used. Improper composting can result in residual populations of potential pathogens in outer layers that don't reach sustained peak temperatures. A sixty day preplant interval for soil incorporation is the generally accepted standard as a further preventive measure. Recent research, however, has demonstrated the potential for pathogens, such as *Escherichia coli* O157:H7 to persist in bovine feces beyond this interval at a range of environmental conditions (Wang et al., 1996). The growth potential of *E. coli* O157:H7 on packaged lettuce in simulated commercial distribution conditions (temperatures of 7-10°C = 44.6-50°F) has been demonstrated (Abdul-Raouf et al., 1993).

***E. coli* O157:H7**

E. coli O157:H7 is of particular concern because temperature management of fresh produce, while still very important, is not a sufficient preventive measure. Small numbers of *E. coli* O157:H7 (10 to 1000 cells) are estimated to be sufficient to cause illness. Contamination alone from soil or irrigation water could potentially represent a hazard to highly sensitive individuals. *E. coli* O157:H7 has been detected in the feces of many animals including dairy and feedlot cows, poultry (especially chicks), lamb, piglets, domestic pets, deer, waterfowl, and children. Clearly, intermingling farm animals and vegetables during production is not a recommended practice. *E. coli* O157:H7 has been shown to persist in drying manure and to be present in incompletely composted dairy and feedlot waste. Persistence in manure-

amended soils is not well characterized and is the subject of current research efforts at UC Davis. The duration of survival in soil, transfer to, and potential colonization of above-ground plant tissue, such as leafy lettuce, are largely unknown for this and related pathogenic strains. This information will be critical in the development of guidelines for the safe handling and application of animal manures to farm land, particularly for vegetable production systems.

A Common Sense Approach

Until more specific information is available about the environmental dissemination and persistence of *E. coli* O157:H7 and other key pathogens, common sense approaches to on-farm microbial safety will go a long way to minimizing the risk of foodborne illness. Some farming practices that were considered safe in "the good-old-days" are a current liability. Some new practices developed as a source of supplemental organic nutrients and pest control (foliar applied manure slurries) seem ill-advised without greater process control information. Awareness of the known traits of these microbes that make them a threat will help each individual grower and handler of fresh produce design prevention and control measures specific to their cropping situation or postharvest system.

References:

Abdul-Raouf, U.M., L.R. Beuchat, and M.S. Ammar. 1993. Survival and growth of *Escherichia coli* O157:H7 on salad vegetables. Appl. Environ. Microbiol. 59: 1999-2006.

Wang, G., T. Zhao, and M. Doyle. 1996. Fate of enterohemorrhagic *Escherichia coli* O157:H7 in bovine feces. Appl. Environ. Microbiol. 62: 2567-2570