Composting Criteria for Animal Manure

Manure that has undergone appropriate treatment to inactivate human pathogens can be a safe soil amendment for use in agriculture. However, incomplete treatment of manure can lead to survival of human pathogens that could contaminate produce in the field and, ultimately, lead to foodborne-illness for those who eat the produce.

There are, at this time, no universal standards for composting that ensure that *E. coli* and *Salmonella* microbes are eliminated during the composting treatment process.

The Composting Process

The three typical types of composting systems include:

1. Passively or actively aerated static pile systems;
2. Windrow systems in which the compost feedstocks are mixed into narrow trapezoidal elongated rows and turned systematically on a regular schedule; and
3. In-vessel systems in which a constructed containment structure houses the compost feedstocks and is equipped with some means of forced aeration.

During the composting process, there are three stages to successful pathogen inactivation:

- Stage 1 - Mixing the compost. Carbon amendments are added to nitrogen rich material to produce an environment that encourages the growth of healthy microorganisms.
- Stage 2 – Raising the pile temperature. The pile is left to self-insulate, and heat rises as the matter is broken down by the microorganisms. Turning the pile to aerate the matter and allow the composting process to continue is a key element to success during this stage.
- Stage 3 - Curing. As the microorganisms work is completed, the heat of the pile is reduced, and the process slows.

There are several key elements to the safe and effective inactivation of pathogens in the process:

- Heat, specifically developing and holding compost pile at temperatures above 55 degrees Celsius (or 131 degrees Fahrenheit) for a time determined by the type of composting being performed.
- Moisture is shown to increase the high-temperature zone within compost piles, and moist heat is known to be more destructive to pathogens than dry heat.
- Turning the pile, or in the absence of turning, adding chemical and physical factors will aid in pathogen inactivation. Exposure to the sun and creation of an acidic environment in the compost is known to lead to more effective pathogen inactivation.
- Avoiding heat-shock. If the pile is exposed to non-lethal temperatures above 40 degrees Celsius (104 degrees Fahrenheit), proteins are created that aid in the survival of pathogens at higher temperatures.

3300 Whitehaven Street, NW | Suite 5000 | Box 571444 | Washington, DC 20057 | ph: (202) 687-2937 | f: (202) 687-2939 | www.producesafetyproject.org

Oversight

There is a wide variety of organizations and standards monitoring the process and end product in composting today.

Within the U.S., composting of animal manure is not specifically regulated by any federal agency. Instead, state and local regulations provide oversight and their guidance varies dramatically in scope and complexity.

Many jurisdictions turn to the Environmental Protection Agency's (EPA) 40CFR Part 503 specifications for regulating land application of Class A composted sewage sludge. These criteria include both end-product and process criteria. These guidelines look at:

- Density of *Salmonella* or of fecal coliform in the end product;
- Time and temperature during the composting process.

Because of the lack of cohesive, uniform standards nationwide, a number of organizations offer independent verification programs. They include the:

- California Compost Quality Council Organization
- U.S. Department of Agriculture National Organics Standards Board
- United States Composting Council (which administers the Seal of Testing Assurance (STA))

While all these organizations have made attempts to regulate and document the elements of safe and effective composting, several issues are not addressed:

- Time and temperature standards vary among groups providing verification programs.
- Finished product spot testing is a necessary component to ensure consumer safety. However, spot testing cannot verify whether the process is successful, unless an initial test is conducted to determine the presence and prevalence of pathogens at the outset.
- There is no agreement among the organizations with regard to the required frequency of facility monitoring.

Recommendations

To increase the safety of animal manure composting, the following additional standards should be adopted:

- Require insulating covers on all types of compost piles. Covers help ensure the inactivation of pathogens and eliminate the need for turning compost.
- Include a minimum curing period to ensure the completion of pathogen inactivation.
- Procedures to control risk. Examples include: regular verification of equipment accuracy, and requiring detailed weather condition reporting.
- Require compost operations to submit for review its SOPs along with its quality assurance plan and a hazard analysis critical control point (HACCP) program. An inspector for the certification body would then verify implementation of these protocols during an on-site visit.

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