Cornell Waste Management Institute

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COMPOST FACT SHEET #3:

Improving and Maintaining Compost Quality

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Management practices have a significant influence on the quality of compost.

Overview

Many different factors determine the quality of composts. While some, such as precipitation and ambient temperature, are clearly beyond the control of compost producers, many other factors can be managed with proper planning. Examples include type of equipment used for turning, frequency of turning, quantities and/or ratios of feedstocks, and composting method. Understanding the interactions and trade-offs associated with such factors will help compost managers adjust the quality and consistency of their compost product.

While farmers may have limited options for what sort of compost they can produce, small changes in how a compost system is managed can result in a more marketable product. For example, if a manager has problems with weed seeds, increasing the frequency of turning may solve the problem, because weed seeds will be exposed to high internal temperatures for longer periods of time. The ability to make small adjustments without incurring significant additional costs makes it easier to customize a compost product for a specific end use. (For more information on different compost end uses, see Fact Sheet #1 of this series.)

In any composting system, there are trade-offs. Compost managers need to understand their product thoroughly and be well-informed of what is demanded for its end use. A decision tree (Figure 1) can help a compost producer think through the choices. There are logistical and economic constraints in any compost management situation, so production limitations and consumer needs should be prioritized. Once the compost producer has an understanding of these, reasonable changes and adjustments can be made to improve compost quality.

Managing a pile well requires optimizing the moisture content and the ratio of carbon to nitrogen in the mix, ensuring that the particle size allows good airflow, and monitoring temperature. Turning serves to homogenize feedstocks, incorporate air and reduce particle size. If a good mix is developed, micro-organisms can function efficiently and air will circulate through the pile naturally. If temperatures throughout the pile are thermophilic (between 130°F and 160°F), the pile is functioning well and turning will only force productive microbes to expend energy recolonizing.

In dry weather conditions, moisture will be hard to retain and more turning will dry out the piles. If the material is dense and does not allow for air flow, more turning will be necessary simply to keep the microbes working. If the pile is too wet, turning more frequently will incorporate air and drive off moisture. Monitoring piles for temperature, oxygen and moisture can help a compost producer make management decisions.

If temperatures fall below 110°F, turning to restructure the pile may return it to a thermophilic stage. At emperatures over 180°F, there is a risk of spontaneous combustion. Adding moisture while turning will cool the pile.

Management Scenarios that Impact Compost Quality

To help farmers and other composters better understand the interactions between management and compost quality, the Cornell Waste Management Institute (CWMI) conducted a two-year study of twenty-five agricultural composting operations across New York State. These farms included both dairy and poultry facilities producing compost. Specific management practices examined included pad type, turning frequency of compost piles, and type of equipment used. Some key results of this study are summarized in Figure 2 and discussed below.

View the full results of CWMI's NYS Agricultural Compost Quality Project:

http://compost.css.cornell.edu/mlreporthome.htm

Impact of Different Turning Rates

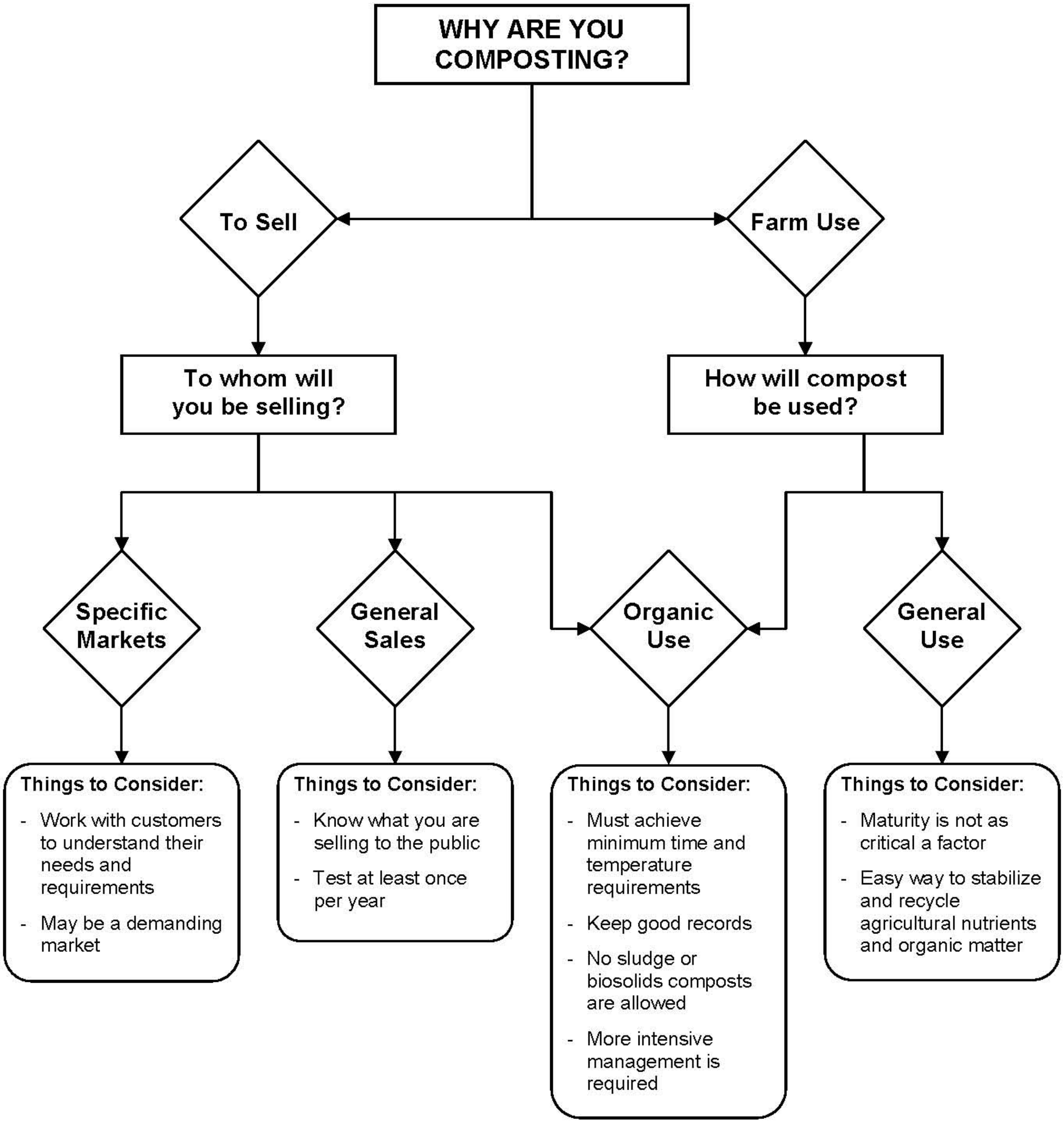
Analysis of the study data showed that lower nitrogen (N), lower organic matter, higher maturity, and lower viable weed seed content were associated with turning frequencies greater than twelve times per year. Lower N would be expected since turning provides greater opportunity of ammonia volatilization. Although lower viable weed seed content was found in the more frequently turned composts, good weed seed control can be provided as long as the seeds are exposed to thermophilic temperatures and weed seeds aren't allowed to blow onto finished piles.

The association of higher turning with lower organic material and higher maturity can be anticipated since turning will help break down particle size, homogenize the pile and speed the stabilization process to an extent. However maturity cannot be expedited much because it is a natural aging process. Even with in-vessel compost systems where there is better control of moisture and air, substantial curing time is still required. In making decisions about turning, composters need to consider the trade-off between the limited acceleration of stabilization that could result from more turning and the reduction in organic matter and N which may be important to a compost user.

Impact of Different Turning Methods

The study looked at three turning methods; dedicated windrow turners, bucket loaders and passively aerated systems (static non-turned piles). Passively aerated systems were associated with the highest nitrogen and organic matter contents of the three turning methods since without the increased aeration that is provided though the turning, it is more difficult for the oxygen-dependent microbes to break down the organic matter. Without turning, less of the pile would be exposed to the atmosphere thus less of the ammonia-N would be volatilized. Passively aerated systems were also associated with lower maturity. The lower N and organic matter found in systems turned with bucket loaders as compared to windrow turners may be related to the incorporation of mineral soil directly from the compost pad which dilutes the compost.

Figure 1. Decision Tree for Improvement and Management of Compost Quality



Compost guidelines are available at:

http://compost.css.cornell.edu/market-label/guidelines/home.htm

Impact of Different Pad Types

Differences can be found among composts that are produced on dirt surface pads compared to improved pad materials such as gravel or concrete. The study found that total N and organic matter are lower in products that are made on an unimproved earthen pad than on other types. As compost is mixed, either with a turner or a bucket loader, soil is incorporated into the compost, in effect diluting it. The end result can be a relatively low nitrogen, low organic matter compost. In a comparison of facilities that use concrete surfaces to those that don't, similar results were found. Non-concrete compost pads produced composts that were lower in organic matter and total nitrogen. Potassium and pH were also lower at non-concrete sites, and weed seed counts were higher.

Managing Facilities to Improve Compost Quality

Because many variables are involved in composting, managing a facility that handles multiple organic waste streams is a complex task. Characteristics such as moisture content, carbon to nitrogen (C:N) ratio, organic matter, nutrients, and many others can change significantly depending on the type of material being used. In farm operations, the number of variables influencing compost production is high, and might encompass herd size, operational costs, equipment and labor availability, type of bulking agent, and others.

COMPOST FACT SHEET #6:
Compost Pads
http://cwmi.css.cornell.edu/compostfs6.pdf

All of these factors have the potential to influence compost quality. To help farmers manage the complexity of combining multiple farm-based materials for composting, Cornell University developed a model that incorporates many facets of production and management into a user-friendly Microsoft Excel Workbook (see Figure 3). Called "Co-Composter," the model requests basic farm data relating to manure, feedstocks, bulking agents, economics, space requirements, equipment, and much more. Co-Composter then returns a detailed operational and economic summary that can be used to optimize the composting operation.

COMPOST FACT SHEET #7:
Compost Equipment:
http://cwmi.css.cornell.edu/compostfs7.pdf

Figure 2. Findings from CWMI study of agricultural composts

Scenario #1 – Different Turning Rates

	Total Nitrogen	Organic Matter	Maturity	Weeds
High Turning Frequency	Lower	Lower	Higher	Lower
Low Turning Frequency	Higher	Higher	Lower	Higher

High turning frequency=>12x/year, low turning frequency=<12x/year

Scenario #2 – Different Turning Methods

	Total Nitrogen	Organic Matter	Maturity
Windrow Turner	Higher	Higher	Highest
Bucket Loader	Lowest	Lowest	Higher
Passively Aerated	Highest	Highest	Lowest

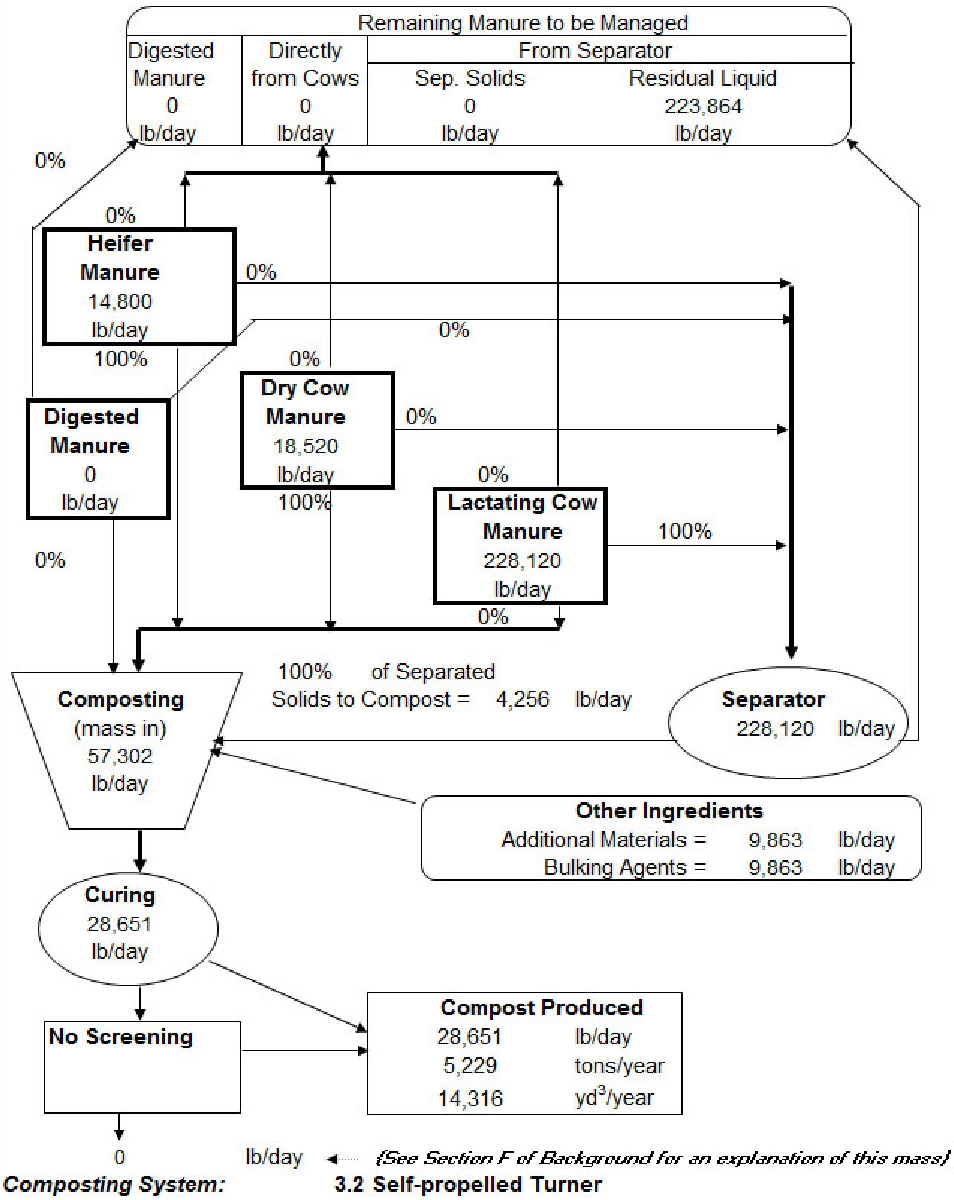
Scenario #3 – Different Pad Types

	Total Nitrogen	Organic Matter
Dirt Pad	Lower	Lower
Improved Pad	Higher	Higher

Download the Co-Composter Model:

http://compost.css.cornell.edu/CoCompost.html

Figure 3. Example of Co-Composter System Mass-Flow Diagram



Compost facilities have many variables. The Co-Composter Economic Model helps managers assess capacity and efficiency.

Acknowledgement

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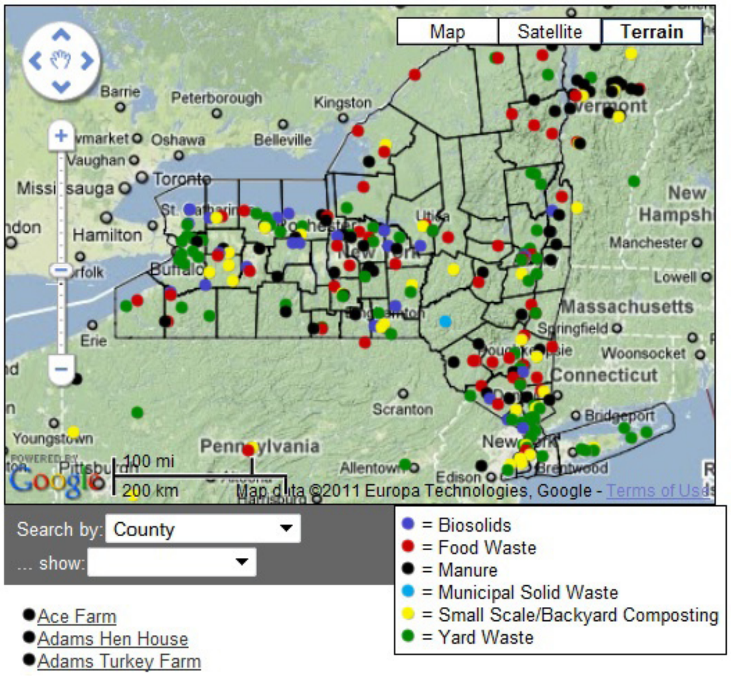
New York State Compost Facilities Search

A map of compost facilities, transfer stations, and compost education and demonstration sites in NY and surrounding states can be accessed at: http://compost.css.cornell.edu/maps.html (see example below).

Please check the map and help us update the information by letting us know of additional facilities or other changes.



Cornell University Farm Services Compost Facility

Website: http://cwmi.css.cornell.edu/farmservices.pdf

County: Tompkins
Owner: Public, College/University
Contact: Bill Huizinga
Address: Stevens Rd; Ithaca, NY 14850
Phone: 607-257-2235
Fax: 607-257-2237
E-mail: glt4@cornell.edu

Feedstocks

- **Food Waste (Pre and/or Post Plate):** Yes
- **Floral waste and trimmings/plants:** Yes
- **Manures:** Yes, research animal bedding - ; Cow, Poultry, Horse
- **Other Feedstocks:** compostable serviceware

Source of Feedstocks

- **Greenhouses/Florists:** Yes
- **Restaurants:** Yes
- **Manure:** Yes
- **Additional Information:** All material comes from Cornell University campus facilities, no waste is accepted from outside the University. A tipping fee is charged to fund the site operation. The food waste includes pre and post consumer waste along with a large amount compostable paper and dinnerware items.

Compost Process

- **How is waste composted?**Piled in windrows

Finished Compost

- **Is compost for sale?:** Yes
- **Is compost used on site?:** Yes

Composting Resources:

- **Farm-Based Composting: Manure & More video - http://hdl.handle.net/1813/14193**
- **Natural Rendering: Composting Livestock Mortality & Butcher Waste:**
  Fact Sheet - http://compost.css.cornell.edu/naturalrenderingFS.pdf
  Video - http://hdl.handle.net/1813/7870 (English); http://hdl.handle.net/1813/22942 (Spanish)
- **Co-Composter - http://compost.css.cornell.edu/CoCompost.html**
- **Compost...because a rind is a terrible thing to waste - http://compost.css.cornell.edu/FoodCompostpr.html**
- **On Farm Composting Handbook - http://palspublishing.cals.cornell.edu/nra_order.taf?_function=view&ct_id=6 or http://compost.css.cornell.edu/OnFarmHandbook/onfarm_TOC.html**

For a complete listing of our composting resources go to: http://cwmi.css.cornell.edu/composting.htm