

Aerobic composting affects manure's nutrient content

The nutrient content of composted dairy manure varies, influenced by a number of management factors

By Brian Aldrich and Jean Bonhotal

AEROBIC COMPOSTING IS THE CONTROLLED DECOMPOSITION of organic materials by microorganisms in the presence of oxygen. Composting dairy manure creates a biologically stable product with reduced odors.

Composted dairy manure also handles well and can be stored for long periods of time. It attracts fewer flies, has fewer pathogens and weed seeds than raw manure, and is an excellent soil conditioner for both farm and garden. Composting reduces the mass and volume of raw manure and transforms it into a product that is more easily exported off the farm, which is one solution for dairies that have excess nutrients.

During the composting process, microbes that thrive in the presence of oxygen break down the organic material in the manure. A moisture content of 60% is needed for optimum composting of dairy manure. Raw dairy manure is mostly water – 88% moisture, feces and urine combined.

Bedding may further reduce the water content, but additional dry bulking materials are generally needed to lower the moisture content to 60%. Yard waste (sticks and leaves), wood chips and paper pulp make good carbon sources.

With energy sources, nutrients, moisture and oxygen present in a compost pile, microbes can begin their work. Their respiration produces carbon dioxide, which is lost to the atmosphere. Respiration also produces heat that drives moisture out of the pile. Ideal temperatures for active compost piles range from 120 to 160 degrees. At this temperature range, pathogens and weed seeds are destroyed.

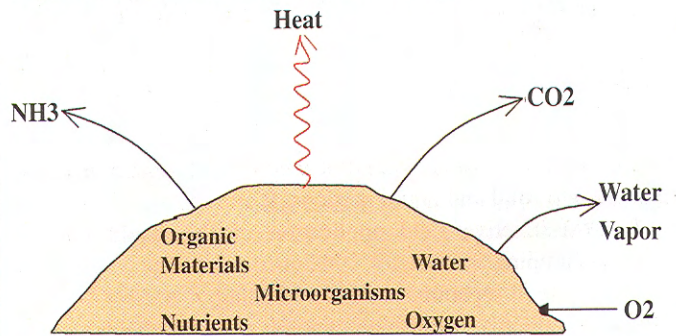
The gaseous losses of carbon dioxide and water vapor are the two main pathways by which mass is lost. (Figure 1) By the time the compost is finished, the mass and volume of the original material may be reduced by 50% or more.

Where do nutrients go?

Initially, almost all of the nitrogen (N) in raw manure is in organic form. As decomposition progresses, organic N is converted to ammonia N. This may volatilize and be lost to the atmosphere or be converted to ammonium, which in turn is converted to nitrate. Nitrate is very soluble and may be lost from the pile if leaching occurs. N losses may amount to 50% or greater.

Since all, or nearly all, of the phosphorus (P) in raw manure is in organic form and there is no volatile-loss pathway for it, P

Figure 1. Mass and nutrient flows in a compost pile



losses may be small to negligible in composting systems. Thus, composting tends to concentrate P in the finished material. Potassium (K) also has no volatile-loss pathways, so composting tends to concentrate it in the finished material. The K in raw manure is already in an inorganic, soluble form and is also subject to leaching losses from the pile, if leaching occurs.

The occurrence of leaching depends on the management of moisture in the pile, on whether the pile is covered, and on the balance between rainfall vs. evaporation if the pile is uncovered. A well-designed compost site will catch and contain runoff through such methods as sod filter strips and catchment basins.

The majority of the N and P in finished compost are in stable organic forms that will continue to degrade slowly when applied to soil, becoming gradually available to plants. K is immediately available. The final concentration of nutrients in composted manure will depend on a number of factors:

- The amount and type of bulking materials.
- The frequency of turning the pile.
- The type of pad.
- Whether the pile is covered.

Since the nutrient content of manure compost is variable, sample and test it before applying it to cropland. ■

Jean Bonhotal is a senior Extension associate with the Cornell Waste Management Institute. Email: jb29@cornell.edu. Brian Aldrich is an Extension associate in the Department of Biological and Environmental Engineering. Email: bsa9@cornell.edu.

For fact sheets on farm-scale composting, see the compost pages on the websites of the Cornell Waste Management Institute and Manure Management Program:

<http://cwmi.css.cornell.edu/Composting.html>

www.manuremanagement.cornell.edu/HTMLS/Composting.htm

The On-Farm Composting Handbook is available from NRAES.

Tel: (607) 255-7634. www.nraes.org/publications/nraes54.html