The National Centre for Livestock and the Environment
environmental stewardship
farm productivity & viability
food quality & safety
animal health & welfare
efficient energy & water use
University of Manitoba

COMPOSTING MANURE AND OTHER ORGANIC MATERIALS

BENEFICIAL MANAGEMENT PRACTICES (BMPs) FACTSHEET

WHAT IS COMPOSTING?

Compost is a soil amendment and source of essential nutrients.

Composting is the controlled management of a naturally occurring biological process called aerobic decomposition. When properly managed, composting microorganisms break down and stabilize organic materials over time to produce a uniform soil amendment and source of essential nutrients - compost.

Composting is an additional manure nutrient management and soil improvement tool for livestock producers to consider. Composting benefits include improved manure properties, reduced environmental risk and potential economic advantages.

WHY COMPOST?

Composting reduces manure volume by over ½ and destroys pests

- Compost Benefits:
  - Reduces manure mass and volume over ½ (lower hauling costs); concentrates nutrients
  - Eliminates unpleasant odours
  - Destroys weed seeds, parasites and pathogens
  - Source of stabilized slow-release nutrients
  - Reduces risk of loss to ground or surface water because nutrients are in more stable forms
  - Improves soil properties such as porosity/ aeration, water infiltration and retention capacity, soil organic matter content
  - Compost has a uniform, soil-like quality
  - Suitable for storing because of stability

WHAT IS REQUIRED TO START COMPOSTING?

- Suitable composting site that meets regulations:
  - Setback distances from water sources and property lines; all-weather accessibility
  - Sized to accommodate composting equipment and planned amount of materials
  - If this is a permanent site, a regulatory permit is required for both the site and runoff collection basin
- Composting starting materials: manure and co-composting organic materials
- Equipment for mixing materials and for forming and turning windrows:
  - Windrow management: Dedicated compost turner, tractor+compost attachment or front end loader
  - Other: vertical mixer to blend materials; manure spreader to form windrows and haul compost
- Calculator tool or formulas for determining mixing ratios according to C:N ratio and moisture content; lab analyses or book values for C:N ratios
- Recording sheets for monitoring moisture and temperature and characterizing windrows
- Compost thermometer (1 m, 3')
- Access to water

Use a calculator tool to determine mixing ratios

Table 1: Composting materials properties.

Starting Material	C:N ratio	Moisture
Agricultural Sources		
Cattle manure	20	Medium
Dairy manure (solid)	16	Medium-high
Poultry manure	15	Low-medium
Pig manure (liquid)	5	High
Wheat straw	100	Low
Hay (legume/ grass)	20	Low
Other Sources		
Wood chips	100	Low
Sawdust	350	Low
Leaves	60	Medium
Grass clippings	20	High
Vegetable waste	13	Medium-high

COMPOSTING TIPS FOR SUCCESS

There are three critical factors to manage for successful composting, which equate to creating an ideal environment for composting microbes:

- **Starting Carbon : Nitrogen ratio**: Target **C:N ratio is 30:1**, although a range of 25-35 will still produce good quality compost if properly managed. High C:N = decomposition will not occur or will be very slow; low C:N = overly rapid decomposition resulting in excess NH_3 loss and potential odour if decomposition becomes anaerobic (no oxygen)
- **Moisture Content (MC)**: Maintain a **MC of 45-60%** (optimal 55%) throughout the active composting phase; too low MC = composting is slowed or stopped; too high MC = too little aeration, resulting in elevated odour and gaseous losses (due to anaerobic decomposition)
- **Particle Size**: Windrows with a mix of particle sizes (6 to 75mm, 0.25 to 3") have good structure and airflow, but will not dry out too quickly. Smaller particles allow greater contact between microbes and materials.

MANAGING THE COMPOSTING PROCESS

There are three distinct phases during active composting, followed by a Curing Phase:

- **Hot Phase:** Maintain temperatures above 55°C (131°F) so that pathogens and weed seeds are destroyed.
- **Warm Phase:** Temperatures should be above 40°C (104°F) for reducing plant toxic compounds which may have been produced during hot and early warm phases
- **Ambient Phase:** Temperatures will gradually decrease to ambient temperature as microbial activity slows and the active decomposition phase comes to an end.

Monitoring and turning needs are highest in the first weeks of composting - the Hot Phase

Management:

- Use a calculator tool to determine the proper mixing ratio for starting materials
- Thoroughly mix compost starting materials as recommended to achieve moisture and C:N targets
- Form uniform windrows of medium size to better manage moisture and aeration
- Regularly monitor and record temperature and moisture. The need for active windrow management is highest during the hot phase when decomposition is most rapid so that composting microbes are provided with adequate oxygen, moisture and "food" (digestible materials).
- Move finished windrows into piles for the curing phase (approximately 21 days)

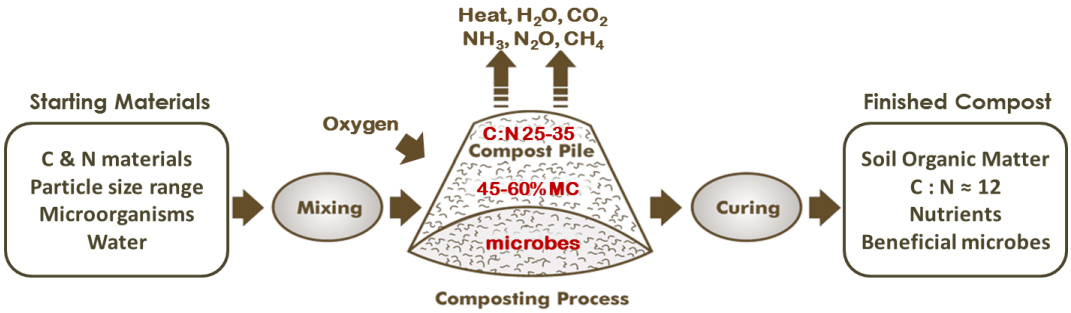

Figure 1. Simplified composting process (adapted from Alberta Agriculture, Food and Rural Development, 2005).

IS IT COMPOST?

To be considered fully composted, the following criteria are to be met:

- Exceed 55°C for at least 15 days with at least five turning events during this period
- The final Curing Phase is to be at least 21 days
- Compost is free of pathogens and meets trace element and foreign matter limits
- Meets stability ("doneness") requirements
- Run nutrient analyses to determine nutrients, salts and other agronomic information

True compost meets specific criteria established by the CCME

DISADVANTAGES

- N loss - Greenhouse gases and ammonia (NH_3) gas are emitted during composting
- Requires extra time, labour and resources
- Additional equipment and land/space requirements
- Subject to weather conditions - can result in large time delays

TROUBLE SHOOTING

Problem	Possible Cause	Management
Unpleasant odour	Anaerobic conditions	If excessive moisture add dry material If poor structure, add "fluffy" or "airy" material or add material with larger particle size If windrow is large, reduce size to improve aeration
Ammonia odour	Too much nitrogen	Add C-rich material such as straw or wood chips
Windrow is too hot (>70C)	Windrow is too large	Increase monitoring for moisture and reduce windrow size if needed
	Not enough carbon	Add some C-rich material such as straw or wood chips
Windrow does not heat	Too dry	Add water and turn windrow
	Too small	Combine windrows to increase size
	Too wet	Turn windrow to improve aeration; add dry material
	Not enough nitrogen	Mix in N-rich material such as manure (low bedding)
Windrow does not re-heat	Too dry	Add water and turn windrow
	Too wet	Turn to aid drying
	Compost is near finished	Pile windrow for curing

Numerous composting resources and tools are available online

RESOURCES

NCLE website http://umanitoba.ca/afs/ncle/programs/composting.html

- Composting calculator tool for determining starting material mixing ratios
- Composting protocol (includes formulas for calculating moisture content, bulk density and the self-heating test to assess compost stability and sampling procedures)
- Windrow information and monitoring recording sheets (moisture and temperature)

Provincial regulations:

- Manitoba Livestock Manure and Mortalities Management Regulation, M.R. 42/98. Available at: http://web2.gov.mb.ca/laws/regs/current/_pdf-regs.php?reg=42/98 (accessed Sept. 2016)

Additional composting guides/resources:

- Alberta Agriculture, Food and Rural Development. 2005. Manure Composting Manual. Available at: http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/agdex8875#Introduction (accessed Sept. 2016)
- NDSU Extension Service. 2010. Composting Animal Manures. Available at: https://www.ag.ndsu.edu/manure/documents/nm1478.pdf (accessed Sept. 2016)
- Nova Scotia Agricultural College, On-Farm Manure Management Through Composting. Available at: http://www.nsfa-fane.ca/efp/wp-content/uploads/2014/07/manure_management_through_composting.pdf (accessed Sept. 2016)

Select additional information:

- Canadian Council of Ministers of the Environment (CCME). 2005. Guidelines for Compost Quality. Available at: http://www.ccme.ca/files/Resources/waste/compost_quality/compostgdlns_1340_e.pdf (accessed Sept. 2016)
- Soil and manure analyses (Winnipeg): Central Testing Laboratory Ltd. and Farmers Edge
- Compost analyses (Ontario): A&L Canada Laboratories Inc. http://www.alcanada.com/agricultural-compost.htm
- Solvita compost maturity test kit (6 pk) http://www.alcanada.com/About-Solvita.htm

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