

# Composting Manure

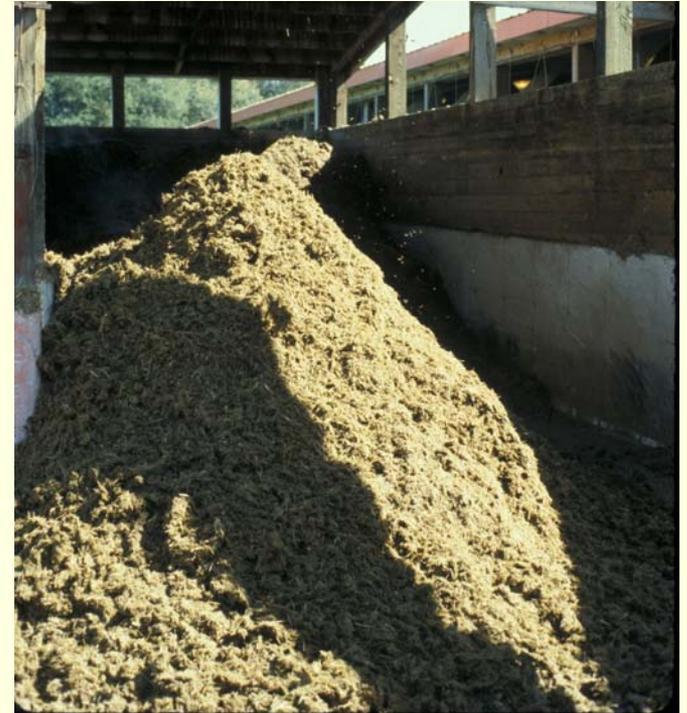
## 2006-2007 Certified Livestock Manager Training Workshops

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# Outline

- What is composting?
- Pros and cons
- Conditions needed for composting
- Performance of composted manure



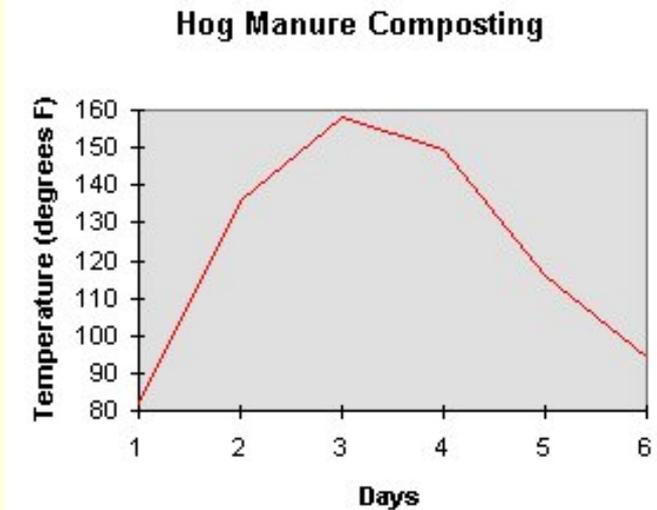
# Some Definitions of Composting

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- **Managed** decomposition of organic materials.
- **Aerobic** decomposition of manure or other organic materials at thermophilic temperature range (104 – 149°F).
- **Biological process** in which microorganisms convert organic materials (manure, sludge, leaves, paper, food wastes, etc.) into a soil-like material.

# Composting is nothing new . . .

- Composting is the same process that decays organic debris in nature. Composting merely controls the conditions so that materials decompose faster.
- Overall, livestock manure is a good composting material.



# What can Composting Manure Accomplish?

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- Reduce manure volume
- Concentrate manure nutrients
- Reduces / eliminates weed seeds
  - Temperature & duration needed is species-dependent
- Reduces / eliminates pathogens
- Improves manure handling characteristics
  - Moisture content reduced from 80 to 20-25%
- Reduce odor of manure
- Easier to spread
  - More uniform particle size
- Value added product, if market available
- Compost being used as bedded-pack in dairy barns

# Some Disadvantages of Composting Manure

- Loss & reduced availability of nutrients ( $\text{NH}_3\text{N}$ )
- Increased processing time
- Cost for handling equipment and labor
- Available land for composting
- Marketing



# Conditions for Rapid Manure Composting

<b>Condition</b>	<b>Reasonable</b>	<b>Preferred</b>
C to N ratio	20:1 to 40:1	25:1 to 30:1
Moisture	40 to 65%	50 to 60%
O <sub>2</sub> Concentration	> 5%	Much > 5%
Particle size, di.	1/8 to 1/2 inch	Depends on material
pH	5.5 to 9.0	6.5 to 8.0
Temperature (°F)	104 to 150	130 to 140

# Another definition . . .

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## ■ C:N Ratio

- The ratio of the weight of organic carbon (C) to that of total nitrogen (N) in an organic material.
- If the ratio is too high (insufficient N), the decomposition slows.
- If the ratio is too low (too much N), it will likely be lost in the form of ammonia gas.

**C is source of energy for microorganisms. N is a nutrient.**

# C:N Ratio of Manure

<b>Livestock Species</b>	<b>C:N Ratio</b>
Beef feedlot	10:1 to 20:1
Swine	15:1 to 21:1
Dairy	8:1 to 30:1
Chicken	4:1 to 18:1
Broiler	6:1 to 24:1
Turkey	4:1 to 18:1

# C:N Ratios of Bulking Materials

<b>Material</b>	<b>C:N Ratio (common range or average)</b>
Corn stalk	60 -73
Straw	80
Bark, hard woods	223
Bark, soft woods	496
Newsprint	398 - 852
Sawdust	200 - 750
Wood chips	641
Leaves	54

# Nutrient Availability from Composted Manure

- Cattle manure compost may lose 50 to 60% of total N. Mainly due to volatilization of  $\text{NH}_3$  -N.
- Compost may contain significant amounts of nitrate-N.
- P & K concentrations in compost are > raw manure; some may be lost via leaching.



# Affect of Manure on Corn Yield

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- 2000 and 2001 near Boone, Iowa
- Fresh and composted hog manure (deep-bedded hoop structure) applied at **total N rate of 300 lbs./acre** in spring prior to planting.
- 2-year average corn yield:

Fresh manure	126.0 bpa
Composted manure	138.7 bpa
	(10% increase)

# N Supply Efficiency of Fresh vs. Composted Manure

Same ISU study as previous slide

<b>Time of Application</b>	<b>Form</b>	<b>N Supply Efficiency* (2-yr. Average, %)</b>
Fall	Fresh manure	24.3
Fall	Composted manure	34.7
Spring	Fresh manure	10.9
Spring	Composted manure	25.0

\* N fertilizer equivalency expressed as a % of total N applied, 300 lbs./acre

Agronomy Journal, 96:214-223 (2004)

# Effect of 3 Bedding Types on Dairy Manure Composting

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- Straw, sawdust, and sand bedded dairy manures were amended w/ either sawdust or straw, and composted.
- Results:
  - All composts stable after 100 days
  - Initial C:N ratios ranged from 25:1 to 50:1
  - Manure N lost during composting was 2 to 38%
  - Neg. correlation between initial compost C:N and N loss ( $R^2 = 0.59$ ) during composting.
  - An initial C:N > 40 resulted in N losses < 10% during manure composting with all 3 bedding types.

# Effect of Composted Beef Feedlot Manure on Coliform Bacteria

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- 1998 and 1999 study in Alberta, Canada with windrow composting of manure from pens bedded with straw or wood chips.
- Numbers of total coliforms (TC) and *E. coli* declined as the composting period progressed.
  - > 99.9% of TC and *E. coli* was eliminated in the first 7 days when average windrow temperature ranged from 92 to 107°F.
- Type of bedding had no effect on TC or *E. coli*.
- Land application of compost instead of raw manure should significantly reduce the risk of water quality degradation.

# Weed Seed Viability in Composted Manure

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- Weed seed viability destroyed by high temperatures (> 140°F) achieved during the process.
- Alberta, Canada study with 5 weed species in 1997 and 13 in 1999 in open-air compost windrows:
  - Compost temperatures as low as 102°F achieved over a 7-day period without turning was lethal for some weed species.
  - Some weed seeds (wild buckwheat) remained viable even after 70 days of composting.
- Factors affecting weed seed viability:
  - Temperature and duration (appear to be species-dependent)
  - Phytotoxic leachates?

# Regulations ?

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- Generally, livestock waste composting on the farm can be conducted and the finished compost applied to farmland **without** a permit from the IEPA.
- A compost permit **is not required** if livestock manure is mixed with farm generated carbon sources such as corn stalks or wheat straw.

# Summary

- 3 important factors to manage:
  - Initial C:N ratio
  - Moisture content
  - Temperature of pile
- Evaluate the composting advantages and disadvantages for **your** operation.
- Composting may be a good option in certain situations, and may make the generated waste more desirable to crop producers.



**Thank you. Best wishes for 2007!**

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