

Turning the compost pile

A compost pile should never be turned during the hot phase. If a pile is turned the practice should be carried out during the cooling phase to limit ammonia loss. The advantages of turning are not clear cut and it is important to balance the pros and cons before turning.

Advantages:

- Remixing the compost mechanically can prevent the likely compaction and consequent seepage due to the ongoing sagging process of the heap.
- Turning will move material from the colder outside edges of the pile to its centre where the higher temperature may reduce the content of viable pathogens and weed seeds.

Disadvantages:

- Turning intensively aerates the material, resulting in an almost complete loss of ammonia.
- Turning a heap results in the material being chopped up. This may lead to a higher density after turning.
- Turning results in added costs for labour and machinery.

Summary

Table 1: Practices that help lower nutrient losses during the composting of animal manure, and those that should be avoided.

Phase	Beneficial practices	Practices to be avoided
Setting up	<ul style="list-style-type: none">• Ensure the cross-section of pile is trapezoid.• Incorporate straw chaff to manure that is low in bedding litter, i.e. has a low C:N ratio.• Add a straw cover.	<ul style="list-style-type: none">• Hollows in the compost pile surface.• Establishing a pile on a windy site.
Hot phase	<ul style="list-style-type: none">• If a pile is likely to dry out• add water.	<ul style="list-style-type: none">• Turning the pile.• Covering the pile waterproof.
Cooling phase	<ul style="list-style-type: none">• Covering the pile waterproof.	

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Literature:

<http://orgprints.org/8098/> <http://orgprints.org/6268/> <http://orgprints.org/4469/>

GRAY & BIDDLESTONE (1981): The composting of agricultural wastes. In: Stonehouse (ed.) Biological Husbandry. Butterworths, London, 99-111

Reducing nutrient loss during the composting process



Nutrients lost from livestock manure compost

During the composting process nutrients can be lost from livestock manure as gaseous emissions and in the effluent as soluble compounds. The main nutrient to be lost is nitrogen, which can be emitted in gaseous form as ammonia (NH₃), nitrous oxide (N₂O) elementary nitrogen (N₂) and nitrogen oxides (NO and NO₂), and leached out as nitrate (NO₃⁻), ammonium (NH₄⁺) or as a soluble organic N compound.

Other gaseous emissions are methane (CH₄) and carbon dioxide (CO₂), which are relevant as greenhouse gases, and hydrogen sulphide (H₂S); while potassium and phosphate can be lost via the effluent seepage into the ground.

Levels of nutrient loss during aerobic composting

In IBDF open air composting trials, which were conducted over an 11 year period, average rates of loss were:

- Nitrogen: 33%.
- Potassium: 17-39%.
- Phosphate: almost zero.



Fig. 1: The issue of farmyard manure management actually begins with the animals and the feeding and housing regimes.

General process of aerobic composting

The composting process is actually the decomposition of organic matter in an aerobic environment. Composting animal manure usually follows the same pattern as composting plant organic matter, and has characteristic temperature changes within the pile that acts as a clear indicator of which composting stage is taking place (Fig. 2).

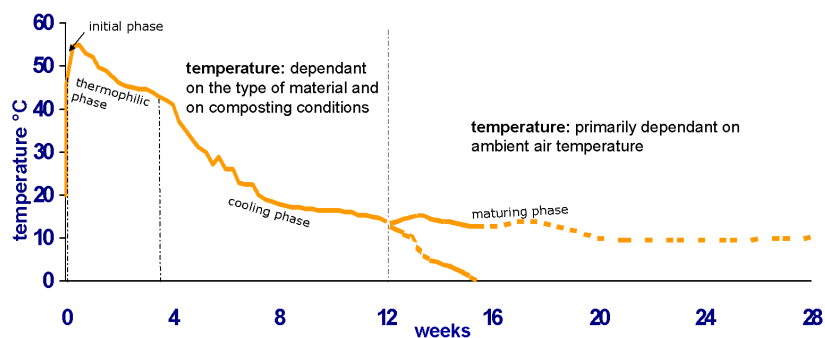
Routes of nutrient loss and their causes

The processes relevant to nutrient losses during composting are complex and inter-related. Although the interactions between water content, ammonia content and temperature level have not been well researched in relation to nutrient loss, two general statements, based on the literature and the IBDF's own trials, can be made:

- Gaseous nitrogen losses can occur throughout the composting process. Ammonia, however, is mainly lost just before, during and just after the hot composting phase (thermophilic phase).
- Soluble nutrients (mainly potassium) are lost when seepage occurs vertically through the compost pile.

Seepage occurs when the compost pile contains more water than the material can hold in its pores. Other than a high water content in the initial material there are three possible causes for seepage:

- Rain or thaw water that soaks into an uncovered pile.
- Respiration water released during the aerobic decomposition of organic substances.
- Expressed water that results from the compression of the material during the sagging process.



Phase	Characteristic Processes	Important Organisms	Result	Duration
Initial	degradation	bacteria	-	few hours to a few days
Thermophilic	degradation	bacteria, fungi	ammonia	1 to 3 weeks
Cooling	conversion	bacteria, fungi	nitrites	4-6 weeks to 3 months
Maturing	synthesis	fungi, animals	humus-like substances and humus	several months

Fig. 2: The different phases of aerobic composting as reflected by temperature; source: table from GRAY & BIDDLESTONE, 1981 (modified), fig. from IBDF data.

Reducing loss from seepage

Loss of soluble nutrients from a compost pile can be kept to a minimum by reducing the quantity of seepage. This can be achieved by:

- Building the pile so it has the minimum surface area in proportion to its volume (Fig. 3).

- Ensuring the surface of the heap is even with no dips where rainwater can collect.
- Covering the pile – after the thermophilic phase – to prevent rain falling directly onto the surface. The pile should not be covered during the hot phase as this would inhibit evaporation, increasing the moisture content of the pile and causing more seepage. A straw cover can be used right at the beginning, but this is insufficient for rain protection.

Despite all efforts to reduce seepage, it is normal for some effluent to be lost from a compost pile. Building the pile on concrete or on a compacted clay surface will prevent nutrients being lost via seepage into the ground. If the pile is near an adjoining liquid manure pit the leachates can be collected and recycled on the farm.



Fig. 3: Optimal cross section of a compost pile with a straw cover. The pile can be of any length.

Reducing ammonia loss during the hot phase

Ammonia losses from the compost pile take place during the hot phase. To keep these losses to the minimum the heating up phase should be retarded. Practices that reduce the loss include:

- Increasing the C:N ratio (to 25-30 : 1) by incorporating chopped straw into the material to be composted will increase the quantity of carbon available. A higher content of available carbon facilitates the re-incorporation of nitrogen into the biomass, and thereby reduces gaseous N losses. However, the extra straw should be added when the manure pile is set up, not to the animal bedding where there is a risk additional urine will be soaked up. Extra urine will proportionally increase the nitrogen and ammonia content leading to a higher loss of ammonia.
- In general, the heat development in a pile can be slowed down by compressing the pile or by adding water. However, either practice must be done in moderation as if carried out excessively they cause seepage and gaseous nutrient losses.

In literature it is often mentioned that there is a correlation between heating and ammonia loss, however the IBDF's research trials have not confirmed this common assumption.