ENVIRO FACT SHEET

Composting By-products on Egg Farms

Composting is a useful way to manage a range of wastes and by-products from egg farming, including layer manure (caged layer manure and barn litter), egg waste and spent hens. In addition to this, the end product can be valuable as a nutrient source and soil amendment for spreading on grazing and cropping land (refer to the factsheet in this series "Spreading Layer Manure").

Composting is a natural process involving the breakdown of organic matter by microorganisms. The resulting product is a humus like material that is a valuable soil conditioner and nutrient source. There are many benefits to using a composting process to manage wastes and by-products, including the reduction of bulk, moisture content and pathogens and the production of a stable, uniform product that does not produce offensive odour when applied to land.

Composting requires careful management of three key components:

1. The Carbon:Nitrogen ratio (C:N)
2. Oxygen supply
3. Moisture level

There are many other management factors that need to be considered when trying to get the most out of a composting process, but most relate to the above components.

C:N ratio

Carbon (C) and nitrogen (N) are the two elements most likely to limit the composting process if they are not supplied in the correct ratio.

Generally, a C:N ratio of between 15:1 and 40:1 will provide for effective composting. Where the C:N ratio is less than 15:1 (not enough carbon), the carbon is consumed without necessarily stabilising the nitrogen in the biological matter. The excess nitrogen can be lost to the atmosphere as ammonia (NH_3) and odour can become a problem. If the C:N ratio is higher than about 40:1, the composting process takes longer to consume the carbon or stalls, because microbial growth is limited by a lack of nitrogen.

Carbon naturally occurs in a range of forms, and this can influence the efficiency of composting as some forms are more readily degraded than others. For example, the carbon found in straw is readily degradable and will compost quickly, while cellulose or lignin fibres found in paper or wood will take longer to compost.

Layer manure, egg waste and carcasses have a very low C:N ratio. For this reason, it is necessary to add a carbon source (i.e. sawdust, straw or cardboard

from egg processing) at a ratio of about 1 part manure/waste to 2 to 3 parts of a carbon source material (by volume). If using cardboard, the process will be helped by shredding the cardboard before composting to increase the surface area.

Oxygen supply

Composting is a process carried out by living organisms in the presence of oxygen. Under aerobic conditions, organisms break down organic matter, producing carbon dioxide as a by-product and very little odour. However, if oxygen is not present (anaerobic conditions) a compost pile may produce offensive odours.

Oxygen supply in a compost windrow or pile is influenced by the size and shape of the pile, the pore space in the material (porosity), the water content of the compost and the frequency of turning. Aeration is usually supplied by frequently turning a pile or windrow, or by using forced aeration in a static pile. Windrows can also aerate as convection forces draw air into the pile when temperatures increase.

Moisture level

Water is a key component in the composting process. Organisms require moisture to survive and increase and the composting process will slow or stop altogether if the moisture level drops too low. However, if moisture levels are too high and the material is too dense (low porosity) there may not be enough oxygen for the beneficial aerobic organisms.

Generally, the preferred moisture content for a compost mix is about 40–65%. Depending on the materials used in the initial compost mix, water may need to be added to achieve the ideal level.

Composting will 'use' water during the process, as moisture is evaporated from the windrows or piles. For this reason, moisture levels should be monitored to keep the material between 40–65% (about field capacity) where the product is moist to touch but does not drip when gently squeezed. One exception to this is for composting of mortalities and spent hens. In general birds have adequate moisture to begin the composting process and may only require a small amount of moisture to wet down the feathers. At later stages in the composting process water may need to be added to ensure the process is successful.

If the windrow becomes too wet odour may be produced. In this case, drying can be hastened by turning the pile or adding more dry bulking material.

Temperature

Composting produces heat, coming from the biological activity of the organisms as they break-down organic matter. The process has a general pattern of temperature fluctuations that can be used to monitor the process.

After initial mixing, the temperature in the centre of the pile generally starts to rise within a few hours. Provided windrows are large enough to maintain the heat generated, temperatures in the range of 55°–60°C will be reached within a few days of start-up. Under ideal conditions these temperatures will be maintained for several weeks before dropping gradually to ambient temperature, at which time the compost process is complete.

Temperature will be self-regulating provided that there is sufficient nitrogen, carbon and moisture for microbial breakdown. Because of this, temperature is a useful indicator for the composting process. Composting is most rapid when the temperature is maintained between 40°–60°C. During the initial phase, a drop in temperature will usually indicate insufficient water, oxygen supply or possibly nitrogen. When the composting process is complete, temperatures within the pile will not rise after being watered and turned.

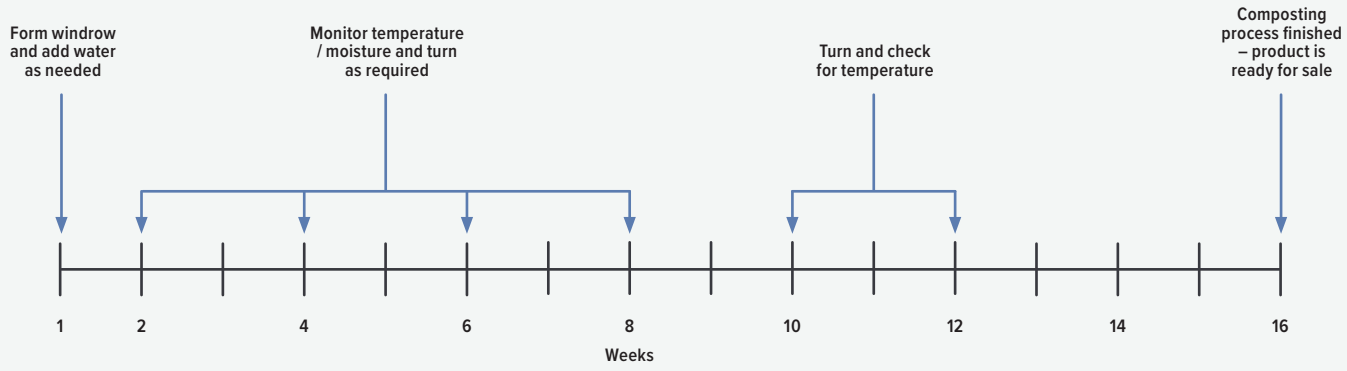

Figure 1. Key time periods during composting

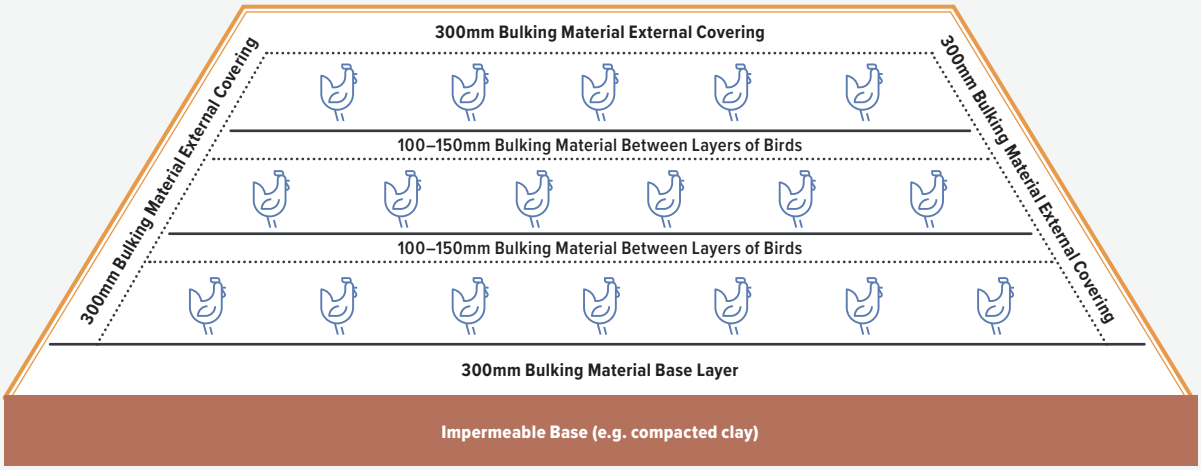

Figure 2. Carcass composting heap design

High temperatures (above 55°C) are essential to destroy weed seeds and pathogens. Turning windrows is important to ensure all of the material is subjected to the high temperatures in the pile centre. This will ensure that weed seeds and pathogens are killed.

General compost management

Composting is generally conducted in windrows 1.5–2m high and 3–4m wide at the base. To maintain enough oxygen, the windrows need to be turned regularly during the initial phase. The process should be complete in about 8–12 weeks, with an additional 4 weeks of curing time. *Figure 1* shows key time periods during the composting process.

Refer to the factsheet in this series "Composting Equipment" for more information on equipment used in composting.

Advantages of composting:

- Produces a consistent product that is safe for reuse in agricultural and residential areas.
- Reduces the weight and volume of the manure and processing wastes by 30–50%.
- Heat generated in the process destroys most pathogens and weed seeds, providing a safer and more widely useable end product.

Disadvantages of composting:

- Adds an additional cost to the treatment process (machinery and labour).
- Nitrogen may be lost via volatilisation and a smaller proportion is typically plant-available compared to un-composted manure.

Carcass composting

Composting is an effective way to dispose of daily mortalities and spent hens. In general, carcass composting follows the same principles as manure composting. However, some differences are apparent. See *Figure 2* for typical carcass composting heap design.

Poultry carcasses have a high moisture and nitrogen content compared to many organic materials. For successful composting, it is necessary to add a carbon source (such as sawdust or chopped straw) to soak up moisture and provide an additional carbon source for the process.

The first step to setting up the compost is calculating the number of mortalities or spent hens for composting To calculate daily mortalities, this will equal the total number of birds multiplied by the mortality rate and divided by the days of occupancy, for example:

10,000 birds x 3% mortality = 300 birds

300 / 365 = 0.8 birds/ d, or = 6 birds / wk.

This gives a total mass of about 12 kg of carcass per week, which will require about 25kg of bulking material (i.e. 0.1m3 of sawdust). Annually, this amounts to about 5m3 of sawdust to compost the 300 birds. Some or all of the completed compost material may be reused for 2–3 years to reduce cost.

Because of the odour and pest potential with carcass composting, it is important that all carcasses are adequately covered with bulking material. This requires coverage with approximately 300 mm of carbon bulking material (i.e. sawdust) to ensure that odours do not escape, and scavengers do not discover the carcasses. One very important consideration with carcass composting is to ensure the process has adequate oxygen at all times during the process. This will reduce the risk of botulism, which is caused by the Clostridium botulinum organism.

Another essential step to reduce the risk of botulism is to ensure that mortalities are managed to avoid anaerobic decomposition occurring before the composting process begins. This can be done by composting mortalities every day or storing mortalities in a fridge / freezer if daily composting cannot be done.

Carcass composting can be done successfully with 1–2 turns of the compost. Unlike regular composting, it is advisable to leave a carcass compost pile for a minimum of 4 weeks before turning the pile to allow time for breakdown of the carcasses. After this time the pile can be turned, but it must be re-covered with about 300 mm of an inert material to ensure carcasses are not exposed on the outside of the pile. An ideal material to use for this is ‘finished’ compost that has been through the cycle once already.

Like all composting, carcass composting needs a good source of carbon. The ideal materials are sawdust / shavings, barn litter or finely chopped straw.

Finely mulched green waste may also be used but wood chips or coarse green waste are not ideal. Layer manure may also be used, but this should be used at less than 25% of the total mix as it does not contain adequate amounts of carbon for effective carcass composting.

To minimise pathogen levels in carcass compost, the compost should be turned three times and reach temperatures of 55°C for three consecutive days after each turning. These temperatures should be monitored, and records maintained.

Compost area design considerations

Carcass composting can be done in many ways; however the simplest option is to construct bays or a windrow with a compacted base, and turn piles one month after the last carcass was added.

Some important factors to consider when designing a compost area include:

- Forming an impermeable base to avoid leaching and improve machinery access,
- Good site drainage to avoid muddy conditions and excessive moisture in the compost. The site may also require bunding to reduce runoff from the site.
- Collect nutrient rich runoff in a sump / dam; this can then be re-used for composting.
- Check licence requirements as some states require a separate licence for composting.

Composting Check List

- ☐ Construct pad for composting operations ensuring the base is impermeable to control drainage, and ensure that runoff is contained.
- ☐ Add manure or spent litter to the pad with additional bulking material.
- ☐ Mix the compost to ensure a C:N ratio of approximately 15:1 – 20:1 (this means adding about 1 to 2 parts sawdust to 1 part caged layer manure by mass – or about 2 to 3 parts sawdust to 1 part manure by volume).
- ☐ Mix the manure with the bulking material and form into windrows, approximately 1.5m high, depending on machinery size.
- ☐ Add water if necessary during windrow formation to make up moisture to between 50–60% (approx. 1000L per tonne of compost mix given above).
- ☐ Monitor windrows to ensure that heating is taking place – record temperature if required by vendors to ensure complete composting of product.
- ☐ Turn piles weekly or bi-weekly (usually when a temperature decline is observed), adding water as required to maintain 50–60% moisture.
- ☐ The composting process is complete when turning the pile will not result in heating (provided all other conditions for composting are met).

Carcass composting Check List

- ☐ Construct bin or bay for composting operations ensuring the base is impermeable to control drainage, and ensure that runoff is contained.
- ☐ Compost birds daily or store birds in a fridge/freezer prior to composting to avoid a build-up of pathogens.
- ☐ Put down a 300mm layer of bulking material (sawdust, straw or other carbon source – not manure) on the bottom of the compost pile.
- ☐ Add mortalities (1.5 birds deep per layer).
- ☐ Wet down the feathers of the birds (if necessary*) and add water if required to ensure adequate moisture levels to maintain microbial activity.
- ☐ Add further bulking material (sawdust, straw or manure mix) at approximately 2:1 ratio of bulking material to carcass mass.
- ☐ Ensure that carcasses are covered with 300mm of bulking material to protect from rodents/pests – use additional bulking material if required.
- ☐ Ensure the pile is peaked so that rainfall will shed from the pile.
- ☐ Ensure carcass compost is not accessible to livestock and that material is not spread on grazing land unless livestock are vaccinated. This will reduce the risk of botulism.
- ☐ Ensure aerobic conditions are maintained throughout the whole process to minimise risk of botulism.

For adding additional carcasses

- Remove the top layer of bulking material, ensuring 100 to 150mm of bulking material remains to cover the previous carcasses.
- Add new carcasses and follow steps 3–7 above.
- Ensure that the overall pile height is no greater than 3 meters.

* Water is not essential for carcass composting.

Troubleshooting

1. "My windrow does not heat up!"

Possible problems

- **Incorrect moisture levels (too much or too little)**
  Aim for 40 – 65% – enough to feel wet without it dripping in your hand when gently squeezed.
- **Insufficient mixing / oxygen**
  Turn windrow and observe again after 6 -12hrs.
- **Incorrect C:N ratio**
  Is there enough nitrogen for biological activity? This should not be a problem unless too much bulking material is added – aim for a C:N ratio of between 15:1 and 40:1. To increase nitrogen, add manure.
- **Unavailable carbon**
  The carbon may be in a form that is not accessible for breakdown. If woodchips or other course material is used, the low surface area and low degradability can inhibit composting. Try using straw or sawdust to provide adequate carbon.
- **The composting process is finished**
  If all other conditions are met and the windrow has been composting for some time, failure to heat after turning is a good indication of completion of the active phase of the composting process.

2. "My windrow is creating excessive odour!"

Possible problems

- **Moisture levels are too high**
  This may be caused by rainfall if piles absorb this water. If this is the case turn the pile and form it to shed water – add more bulking material if required.
- **The C:N ratio too low (too much nitrogen)**
  This can cause ammonia loss and odour production – solve by adding more bulking material.