Vermicomposting *(to go back use your browser's 'back' button)* August 2001

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How does earthworm composting work?

Worms feed on organic material, break it down and then excrete it as worm castings or vermicompost. The castings are in the form of tiny pellets which are coated with a gel. This crumb-like structure helps improve soil drainage and aeration. Worms are constantly tunneling which also helps aerate compost and soil and enables water, nutrients and oxygen to filter down. This is also a major factor in the rapid breakdown of the Eco Nappy.

Why is Worm Compost so good for plants?

The organic matter also undergoes chemical changes in the process. This make the nutrients more readily accessible to plant roots but in a form that is slowly released when required by the plants. Vermicomposting has this same effect on toxins, such as heavy metals found in sewage sludge. The process is called 'fixation' and it prevents plants taking up more than they need. Studies also show significant pathogen reduction in organic matter that has been through the vermicomposting process.

The vermicompost acts like a buffer for plants where soil pH levels are too high or low making soil nutrients available again to the plant The castings are much higher in bacteria, organic material and available nitrogen, calcium, magnesium, phosphorus and potassium than soil itself Vermicompost is biologically active and will continue to condition soils for up to 4 years.

Experiments in the US on tomato crops have shown that adding vermicompost will increase production by up to 33%.

Can Earthworm Composting reduce waste volume?

The vermicomposting process also reduces waste volume (up to 60%) and compacts it giving it higher nutrient intensity and improved water holding capacity.

Is Vermicomposting popular?

Vermicomposting is set to become increasingly popular in the next century as it yields rich organic fertiliser, recovers energy rich resources, safely disposes of organic waste and helps tackle environmental problems such as landfill and the expense of collecting and transporting this waste. In fact, a number of local authorities in Ireland already promote the use of Vermicomposting.

Is Worm Composting Fast?

Vermicomposting is much faster than regular composting. Compost can be ready in 1 month whereas normally it might take 6 months).

Can you suggest some more advantages to Worm Composting?

- Some examples: Waste materials, like food scraps or animal manure, are packed with primary nutrients such as energy, proteins and minerals which were originally costly to produce.

Vermicomposting this waste converts it into a valuable end product and returns these nutrients to the soil where it can be put to good use once again.

- In compost application experiments, plots with added worm compost showed almost the same yield as artificially fertilised plots while plots with added organic compost showed much lower yields. Vermicompost also aids soil aeration and drainage so improving soil condition. Vermicompost is valued highly by gardeners.
- Vermicomposting waste will produce no pollution or unusable residue making it a very effective form of recycling. The organic matter that passes through the digestive tract of the worm is excreted as castings. The by-products of this process are water vapour and carbon dioxide, occurring at the natural rate of organic matter decomposition.

For a sustainable environment, outputs from each production cycle should become inputs to other enterprises as in nature. Vermicomposting is an ideal example, as the worm composting process mimics nature.

Can earthworms deal with toxic substances in the composter?
Some relatively toxic substances can be found in the waste we put into composters. As long as the worm composter is working properly, the worms will be able to handle these substances. Heavy metals become soluble and therefore potentially toxic in acidic environments. Worms prefer a relatively alkaline environment. Normally ground garden limestone is sprinkled into the composter. (Only use garden lime, NOT Quicklime, of course!). Worms carry out fine grinding of the lime particles. This neutralises any excess acidity and liberates plant nutrients stored in the rock. Heavy metals are also fixed in the soil and released slowly avoiding toxicity.

Worms develop and maintain a culture of effective aerobic bacteria by culling pathogens, fungi and anaerobic bacteria. They also ensure the organic mass is well aerated.

How does Worm Composting work?

Vermicomposting is much more complex than worms simply eating and excreting organic material. It is a highly complex chain of chemical, biochemical and biological interactions and reactions. The whole process is based on natural systems which have evolved over hundreds of millions of years. Worms play a vital role in creating the optimum conditions for the beneficial organisms to establish and reproduce. These 'good' organisms compete with and dominate the more harmful microbes. The waste is reduced in volume and increased in nutrient value.

So who's responsible?

It takes more than just the worms to make vermicompost. The worms eat, chew and churn up the waste. The other organisms which accompany them also break it down. A simplified description of the overall mechanism is described below:

1. The worms ingest organic matter, fungi, protozoa, algae, nematodes and bacteria. This is passed through the digestive tract. The majority of the bacteria and organic matter pass through undigested (although the organic matter has been ground into smaller particles). This forms the casting along with metabolite wastes such as ammonium, urea and proteins. The worms also secrete

mucus, containing polysaccharides, proteins and other nitrogenous compounds. Through the action of eating food and excreting their casts, worms create “burrows” in the material. This in turn increases the available surface area and allows aeration.

2. There is an abundance of oxygen and nitrogenous compounds (urea, proteins and NH3) in the excreta (vermicast) and mucus secreted from the external tissues of the worms. Some bacteria require oxygen (aerobic bacteria) whereas some object to oxygen and prefer its absence (anaerobic bacteria). Anaerobic bacteria are responsible for the stench from stagnant drains, refuse sacks and landfill sites. With the aerobic conditions in vermicompost, aerobic microbiological growth increases. It is believed that the initial burst of microbiological activity mainly consists of nitrogen fixing bacteria, nitrification bacteria, and to a lesser extent, aerobic bacteria. This is based upon previously established information that burrow walls have a high proportion of the total nitrogen fixing bacteria and that casts have higher concentrations of soluble salts and greater nitrifying power. Accompanying this microbiological growth is the breakdown of organic nitrogen compounds to ammonia and ammonium.

The good news is that the sweet smelling aerobic process overcomes the ugly smell of anaerobes. That is why worm compost piles (properly fed and maintained) smell so nice!

3. The whole process consumes organic matter and creates a ruffled surface in the burrow walls. The large surface area and improved aeration results in favourable conditions for obligate aerobes (such as Pseudomonas spp., Zoogloea spp., Micrococcus spp. and Achromobacter spp.). The continued growth of the microbiological population continues to increase the rate of decomposition of the material.

Air flows through the material more readily, minimizing the likelihood of anaerobic biochemical reactions occurring. This minimizes the formation of sulfide and ammonia gasses, odors that are typically present if anaerobic conditions are established. Objectionable odors disappear quickly, due to microorganisms associated with the vermicast

What about dangerous pathogens, enteric viruses and parasites?

Naturally, it is important that where potentially harmful organisms are in materials being composted, they should not be present in harmful numbers when the process is finished. With earthworm composting, this is indeed the case.

The vermicomposting process has a profound effect on the levels of pathogens namely E.coli, Faecal Coliforms and Salmonella spp. with reductions of >99.9% possible. Material that is Vermicomposted exhibits greater pathogen reduction than that achieved with conventional composting. As all three of these pathogens are not obligate aerobes (that is requiring oxygen to survive, grow and multiply), it is likely that these organisms are subject to exploitative competition. The obligate aerobes namely Pseudomonas spp., Zoogloea spp., Micrococcus spp. and Aebromobacter spp. have evolved to process nutrients and reproduce at the highest efficiency in aerobic conditions and so the pathogens are excluded from nutrients and space as the obligate aerobes continue to increase under ideal conditions.

A similar reduction in numbers exists for enteric viruses due to the lack of host species, exposure to a microbiologically active environment and the secretion of virucidal enzymes by the earthworms during the digestion process. An identical pattern is observed during the vermicomposting process when examining parasite Helminth ova) numbers, primarily due to the lack of host organisms and possibly direct digestion by the earthworms.

Benefits of Vermicompost

The typical levels of the nutrients (N, P, K) in vermicomposted green waste are of the order of 1-2 %. It would appear that the vermicompost does not compare favourably with commercial chemical fertilisers however two important factors are overlooked when comparing the two, the microbial content and the organic matter content.

Chemical fertilisers are either sterile or have negligible microbiological activity. The chemical fertilisers are composed primarily of water-soluble chemical salts and as such organic material rarely forms part of chemical fertilisers. Once the salts have been depleted from a chemical fertiliser, then re-application is required to maintain the nutrient levels. The presence of nitrifying and nitrogen fixing bacteria in vermicompost means that nitrogen can be fixed from the atmosphere and converted to plant soluble nitrates.

The process continues as long as there is sufficient organic matter (which is present in vermicompost) and so re-application is not required at the same rate as chemical fertilisers. The ability of the microbiologically active vermicompost to regenerate the nutrients from the atmosphere, organic matter and water replaces those lost from chemical fertilisers by leaching, plant uptake and chemical reactions. In relation to moisture holding capacity and improvement of soil structure, chemical fertilisers have negligible effect, as they primarily consist of water-soluble salts. Vermicompost, on the other hand, due to the aggregate nature of the worm castings has appreciable water holding capacity and its use leads to improved soil structure.

Vermicompost requires no curing (as traditional composted materials do) as it is already populated with beneficial microorganisms The overall time required (and hence the cost) for processing is therefore greatly reduced, and the process produces no toxic by-products or waste. The vermicompost itself is highly valued by gardeners all over the world and has a significant market value.

Want to Make a DIY Worm Composter? Please Click Here or *use your browser's 'back' button to go back*

DIY Vermicomposting *(to go back use your browser's 'back' button)* August 2001

Getting Started

Creating a home for your composting worms couldn't be easier. Worms don't need luxury accommodation and any decent sized bin or box can be adapted for vermicomposting. If conditions in the container are correct your worms will thrive eating all your kitchen scraps and some garden clippings (we will deal with larger scale vermicomposting at a later date). Making the environment

suitable for housing worms requires a few simple steps outlined below. If possible reuse/recycle materials you have lying around rather than buying anything. After all that is what vermicomposting is all about.

Containers

Worms are surface feeders. The larger the surface area the better. A surface area of 1/2 square meter and over is acceptable for normal household and small garden waste. A large plastic bin, oil drum or wooden box (without wood preservatives as they would be toxic to the worms) will make a fine home for worms. *Note that for Eco Nappy composting, a larger area is required. (See Plans Here)* Position your container out of direct sunlight on a couple of blocks or bricks to allow free drainage or access to your tap.

Preparing your bin

Air is important

As composting with worms is an aerobic process it is important that whatever container you use allows lots of oxygen in but keeps flies and vermin out. Make a secure fitting lid for the container you are converting. Drill / punch or otherwise make a number of small vents in your bin and cover these with mesh to deter flies.

Drainage matters too

If you add a tap near the base of your bin you will be able to collect any leachate produced to use as a plant feed. If you are not going to fit a tap drill some holes in the base also for drainage. Place a layer of gravel (about 10 cms in the base of your bin with a 10 cm layer of sand on top). Your drainage system is now in place.

Give them a nice bed

The bedding is the worms starter home and safe haven should conditions in the above feed layer become unfavourable. There are many materials suitable for worm bedding but we find the most common types available in or around the home are shredded / torn newspaper or cardboard (preferably corrugated) leaves or manure. Add a good 40 cm layer of this. Don't worry if this fills your bin up a lot it will reduce down quite rapidly once the worms get to work. If you are using only paper or cardboard add a shovelful of soil, as this will introduce many beneficial composting creatures to your bin to work with the worms.

Adding the worms

There are a large variety of worms in your garden but the ones you need are composting worms. These are found feeding on rotting debris. If you have a compost heap or manure pile dig in to the outer layers and you could find a ready supply of free workers. Otherwise you must buy some. Place your worms on top of the bedding and watch as they burrow down into it away from the light.

Feeding time

As there is plenty of feed for the worms in their bedding it is better to feed lightly at first. Add some uncooked scraps at first and check frequently to see how much your worms are eating. Don't add anymore feed until the last lot is gone. Worms will eat almost anything but be careful not to add too much of foods that are very acidic, salty or spicy. If you check on your worms often you will soon get a feel for what is right for them.

To see plans for a worm composter for Eco Nappies, please *See Plans Here*

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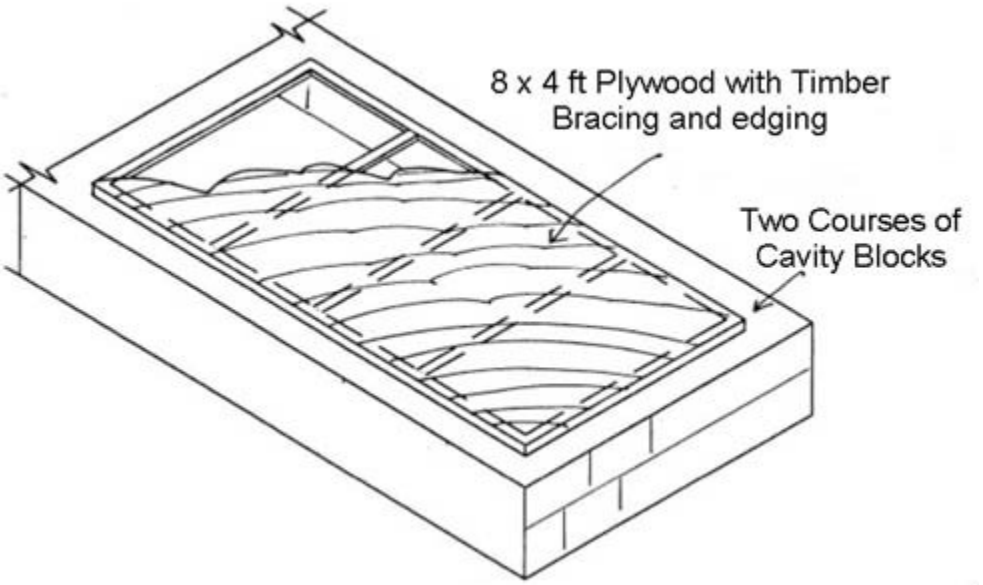
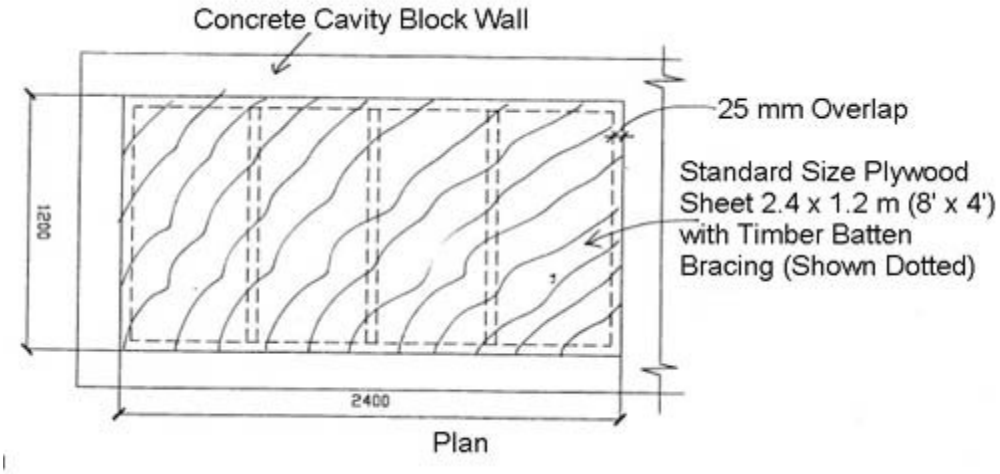
DIY Vermicomposter for Eco Nappies *(use your browser's 'back' button to go back)*

What you need

As mentioned previously, Earthworms are surface feeders. To provide a sufficient surface area for the nappies to be dealt with, the plans shown below have been devised by the Irish Earthworm Company.





The base of the composter should be impermeable, and if possible a drain should be included for the collection of liquid. This liquid is of course a valuable fertiliser. A simple concrete base can be made.

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