

Worm Farming

A Guide to Composting with Worms

Common Worm Species

Eisenia fetida: Pronounced “iSEEnee a FETid a”, is a worm that can process a large amount of organic material in their natural environment. They tolerate large temperature, moisture and pH ranges and can also tolerate handling well.

Eisenia andrei is closely related to the *Eisenia fetida* and is known as the “red tiger”. This worm performs as well as the *E.fetida*, and it does not hurt to have a combination of both worms in your bin.

Lumbricus rubellus is another worm that can be used for composting. Some consider *L.rubellus* to be the true red worm. It is also called the dung worm, or red marsh worm. This worm loves manure and compost piles but has also been found working the earth which makes it doubly effective as the two other worm varieties stay mostly at the surface of the soil. This worm is great to use in indoor compost systems.

Bedding Materials

Worms, like you and me, need both protein and carbohydrates to get a balanced diet. Carbohydrates for worms come from carbon-based bedding materials. To reduce the environmental footprint, try to choose a local material that is a waste product instead of buying something from far away. These can include:

- non-coloured, non-glossy newsprint
- coconut fibre for those living close to the tropics
- peat, if it is a waste product (mined peat is not an environmentally sustainable product)
- shredded office paper
- colourless, gloss-less cardboard
- unbleached paper towel that has been used to wipe counters without chemicals
- toilet paper rolls
- Animal manure (free of antibiotics and worming agents)
- moist straw
- brown leaves
- brown grasses

Environmental Conditions

Composting worms originate from warmer parts of the globe, typically in wet regions. They have evolved to stay above the soil where it is moist, but not too wet. Most of these worms are litter eaters, not soil workers, so it is important to provide them with a moist bed of litter and food. When choosing your worm farm, it must be impossible to drown the worms, so the design must allow for worms to breathe and drain liquid freely.

The worms respire through their skin which is most effective when their skin is moist. The worm’s body is comprised of about 75% water, and therefore if you keep their bedding at the same moisture level, they won’t have to work as hard to breathe, eat, or process their food. To get 75% moisture in their bedding, take 1kg of bedding and add 1.5 kg of water to it. If you are not the scientific type, take the bedding and add enough moisture so that when you squeeze it, only a few drops are extracted from the bedding.

These are the conditions that the worms thrive in.

- Temperature: 15 – 25 C • Moisture: 75%
- pH: slightly acidic • An aerobic environment, i.e. lots of oxygen.

How Much do They Eat?

This depends on climatic conditions, summer to winter and humidity is important. Worms can eat from half their weight to approximately their own weight in food every day. This means, if you have 1 kg of worms, they will eat up to 1 kg of food every day during the warmer months. As your worm population increases, the amount of food you feed them will increase as well!

What not to feed Worms!

Meat, cheese, dairy products, chilli, citrus, bread, pineapple, rice, pawpaw, pasta, vinegars, any type of oils, left over cooking grease, tomatoes, salt, onions or garlic.

What do they produce?

Worms produce the most amazing amendment for the garden!

Worm castings (their poop) is one of the most valuable products that you can introduce into your garden!

It is like probiotic yogurt for your garden! Castings are loaded with beneficial microorganisms (see below) which build fertility in the soil continuously. They are very high in organic matter (also known as OM and soil carbon) and humates which are both extremely important to plant and soil health.

In addition to castings, the worms produce worm juice. This is a great opportunity to recirculate the juice which helps keep the life (micro-organisms) pumping along. If you have 1 litre of juice add 1 litre of rain water and pour over the top to maintain the moisture level. This also helps increase the potency of the juice when you go to spray on your plants.

Some people are even using the juice in modified hydroponic systems and calling it vermiponics!

How do I Use the castings & the juice?

We recommend when sowing seeds or planting seedlings with castings, first dig a suitable size hole beneath the plant root zone. Add half a handful of castings and wet in. Cover with soil then place your seed at the correct depth and cover. Seedlings should have the root ends sitting on top of the wet castings, then surround the plant with soil for stability and water again. Add castings this way every time you plant. If you are harvesting off a seasonal or perennial plant, then add castings every 2 to 3 weeks from flower set to last harvest, always watering in and cover with mulch. It is important to never expose the castings to sunlight!

Our juice concentrate is very potent and can be watered down at rates from 50ml to 15ml in every litre of water. Apply the appropriate mix right to your plants root zone or folia spray when the leaf temperature is at optimum to receive nutrients. Please contact us to discuss this option. First application should be 50ml then reduce to 30ml then down to 15ml maintenance from bud set to last harvest. We recommend applications approximately 10 days apart.

Why use the castings & the juice?

The micro-organisms in both feed plant available nutrients 24-7.

Balanced soil micro-organism activity creates an environment full of plant available nutrients and controls weeds. There are also micro-organisms that help plants fight pathogens and pest insects. If you continue to help these organisms, you do not need any other fertiliser or chemicals, which all kill the biology in your soil.

WARNING!!!

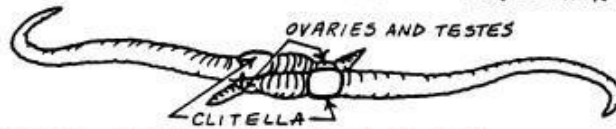
The Sex Life of Worms

EARTHWORM MATING AND COCOON FORMATION

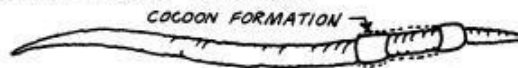
EACH WORM HAS BOTH OVARIES AND TESTES.



TWO WORMS JOIN BY MUCUS FROM THEIR CLITELLA. SPERM THEN PASS FROM EACH WORM TO THE SPERM STORAGE SACS IN THE OTHER WORM.



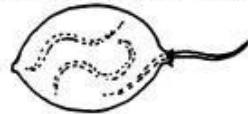
LATER, A COCOON FORMS ON THE CLITELLUM OF EACH WORM. THE WORM BACKS OUT OF THE HARDENING COCOON.



EGGS AND SPERM ARE DEPOSITED IN THE COCOON AS IT PASSES OVER OPENINGS FROM OVARIES AND SPERM STORAGE SACS.



AFTER BEING RELEASED FROM THE WORM, THE COCOON CLOSES AT BOTH ENDS. EGG FERTILIZATION TAKES PLACE IN THE COCOON.



TWO OR MORE BABY WORMS HATCH FROM ONE END OF THE COCOON.

Figure 17. Worms are hermaphroditic.

Illustration 1: from Worms Eat My Garbage by Mary Appelhof

These little composters are both male and female (Hermaphrodite) and are pretty promiscuous. According to Mary Appelhof, author of *Worms Eat My Garbage*, 8 of these worms can reproduce into 680 grams in as little as 6 months. If you extrapolate that, 1000 worms can reproduce into about 81.5kg of worms in as little as 6 months if you have the right conditions. Worms reproduce by rubbing up against each other, exchanging sperm which allows them to produce cocoons. These cocoons can contain as many as 3-4 worms each and can hatch anywhere from 3 weeks to 6 months depending on conditions. Since worms reproduce based on the presence of the right conditions, if there is no new food or bedding, the population is too high, or the whole bin is full of only their castings, they won't reproduce.

Because the amount of breeding these worms do is based on the proximity of other worms (the closer they are, the more bumping into each other they do), a smaller bin will encourage more breeding. If your goal is breeding, you could run a small bin to encourage the worms to reproduce, harvest the cocoons and transplant them into new bedding material.

Sizing Your Worm Bed & Buying the Right Amount of Worms

To size your worm bin, you need to know how much food scraps you are going to produce per day. You can do this by collecting your compost material over a 1-week period and dividing it by 7 days. So, if you collected 4.5kg of food scraps in 1 week, you would be averaging 643 grams per day.

If you are using a conventional worm bin, Marry Appelhof (Worms Eat My Garbage) recommends 450 grams/day of food requires about .130 square metres of worm bin surface.

In this instance I would recommend buying 250 grams to 500 grams of worms and breeding them up to meet your food scrap supply.

Amendments

Availability of minerals in the soil is determined by the life in the soil. It is the soil life that facilitates trading of minerals with exudates (plant-produced sugars) from plants. If the specific microorganism that makes a specific mineral is not available, it has the same effect as not having the mineral available in the soil at all. As the worm system is a “probiotic” system, we can mineralize the castings by adding supplements to the system. I am not a fan of chemicals, so we add natural supplements that have multiple benefits. Because worms have gizzards, instead of teeth, they need to have some grit to help them decompose their food, much the same as chooks. We add agricultural lime every few weeks. The equivalent of 5 grams to every square metre of bedding will provide the mineral supplement as well as the grit for their digestion. Some people suggest Diatomaceous Earth can be used the same way. Either or, it also helps balance the PH. Mixed with the Ag lime is a small amount of mill run or pollard as a treat for the worms.

How to Add Food

When you start your worm system, it is good to start slow. It is easy to overload the system if you are not used to it. Also, worms are only one of the many critters that make the process work, and it takes time for these other critters to start working as well. If you have 500 grams of worms, add 250 grams of food every other day for a few weeks. Monitor the food on a daily basis to see how quickly it is decomposing and being consumed. If it is building up and starting to smell, stop adding food until it is gone.

When adding kitchen scraps, pull some of the castings aside and bury the food under 2cm of castings and bedding. If you have no castings, make sure you cover the food with damp bedding material.

Another technique is to mix the food scraps with damp bedding and wrap it in newsprint. Place this food gift into the compost bin and cover with more bedding. If you don't cover your food with castings and bedding, you can end up with a bit of a fruit fly problem.

To harvest the castings, stop adding food until the majority of it is in the form of castings. If you have a stackable tray compost farm (Worm café or tower), take a scraping off the top of the bedding in the first tray. Add this to the new tray and place that on top of the first tray, add a small amount of food, wet that in and cover. Enticing the worms up into the new tray can be achieved by adding some bran, pollard or mill run to the new tray before wetting in.

If you do not have a worm tower, follow these instructions. Remove the castings onto a plastic sheet and make fist sized piles. Make sure that the room where you harvest the castings is well lit. Worms hate light, so they will go to the centre of the pile to avoid it.

Leave the piles out for 30 minutes to an hour and then start peeling the piles back until you reach the worms. Put the worms back into your worm farm. Now you have castings to add to your garden. These castings will attract earth worms which is exactly what you want.

Worm predators: Keep an eye out for hollow trails through the bedding, this is a sign you have crickets in your worm farm, and they eat worms! The other one is rats. Make sure they cannot get into the worm farm. Strap the lid on firmly! A night time predator of earthworms is the Australian bandicoot which are omnivores, so watch out for them in your garden!

Adding compost worms to your garden:

We have found the most effective method is to stand PVC pipe (90 to 150mm) on its end. Drill a series of 5mm holes all around one half of 1 metre long pipe. Bury at least ¾ of the pipe with the drilled holes end in your garden bed leaving the remainder standing. Place a cap on top. Add the compost worms with some bedding/food material into the bottom of the pipe. You can continue to feed the worms as described earlier, simply add the feed from the top of the pipe and replace cap each time. If you blitz kitchen scraps in a coffee grinder after adding a little water, the worms will find it much easier to consume the food. This method will allow the worms to go out into your garden soil, leave their castings for the plants to enjoy and you don't harvest anything except nutritious food or look at beautiful full flowers. If a bandicoot finds your worm towers, you may have to fence it out!

Troubleshooting:

Fly problem

If you end up with a ton of fruit flies emerging from your system there are a few things you can do to remedy the situation.

1. Bury your kitchen scraps under bedding and castings. The deeper you bury them, the less likely the flies are to lay eggs.
2. try adding animal manure on top of the kitchen scraps and cover with a moist mat.
3. "Gift" wrap your food scraps in newspaper for your worms
4. Add lots of moist bedding on top of your worms
5. Get a small dish and add apple cider vinegar with a drop of dish soap. Place this near the compost bin to trap the flies. Or ask us how to make a fly trap.

Odour Problem

An odour problem is your worm's way of saying, "I have too much food". Stop feeding your worms, Keep moist and wait for the food to be consumed!

Worm Resources

This information came from a number of resources over many years of research, a big thankyou to the unknown names who contributed.

Books:

- Worms Eat My Garbage, Mary Appelhof
- The Worm Book: The Complete Guide to Gardening and Composting with Worms, Nancarrow, Loren

Websites:

There is a lot of contradicting information online. Always confirm from an offline source first!

Beneficial Insects:

<http://www.natural-insect-control.com/index.php>

**For more information or answers to your questions, contact:
Scott Robinson, Phone: 04 1875 0070**

