Composting Worms 101

By Bentley "Compost Guy" Christie

IMPORTANT NOTE: This is a supplemental guide I'm including with various paid educational products. It is not intended to be shared freely. Thanks!

Introduction

I decided to put this resource together to help people with little or no vermicomposting experience get a better understanding of what exactly I mean when I say "composting worms", and how to maximize their potential.

It pains me to see *so many* people obsessed with this idea that worms do best in soil! Yes, there are plenty of beneficial soil-dwelling worms, and yes various composting worms can even do "just fine" in a rich soil.

But is that what we really want? "Just fine"?

I for one want to provide my composting worms with the resources and conditions they need to THRIVE (not just survive).

What may help is to look at the 3 broad categories of earthworms based on where they live in the soil profile. And then we will spend some time looking at the most commonly used composting worms, along with some "in-betweeners" worth mentioning.

Anecic Worms – These are the deep burrowers. They create long vertical tunnels, often extending many feet down into the soil. Many of the larger-bodied worms you find on your lawn or out on a golf course after a heavy rain would be in this category (eg "Canadian Nighcrawler / *Lumbricus terrestris*).

These worms tend to live a fairly solitary life for much of the time, they require fairly cool temps, and are slow to grow and reproduce.

These are absolutely NOT good composting worms – but you may very well end

up with plenty of them on the fringes of your outdoor vermicomposting systems, and their burrows may even help to keep in-ground systems like trenches and pits oxygenated.

Endogeic Worms – These are the mid-range earthworms. They also create burrows but they tend to be closer to the surface and oriented more horizontally. A lot of the worms you might find digging around in your garden would be in this category. These worms will tend to be more tolerant of warmer, more crowded conditions – *but* they are still soil worms, and do not belong in a vermicomposting system (other than when they access outdoor systems on their own).

Epigeic Worms – These are the worms that tend to live up around the surface level (and above) – very often in rich deposits of organic matter. They are adapted for life in these often-transient environments – growing/reproducing much more quickly, and being far better adapted for warm temps and crowded conditions. It's *this* group that includes what I refer to as "composting worms" -

the worms that are very well-suited for converting organic wastes into rich castings much more quickly than their soil-based cousins.

The most commonly used composting worm – and the one I recommend mostly highly is the Red (Wiggler) Worm (*Eisenia fetida/andrei* – actually two very closely related species that often occur in mixed populations). They are tolerant of a wide range of conditions, grow/reproduce quickly, process wastes effectively and are just very easy to work with.

The Red Worms' larger cousin, the European Nightcrawler (*Eisenia hortensis* – sometimes still called *Dendrobaena veneta*) - is a good worm to work with as well, especially in cases where people want to raise a larger worm for bait (etc). But it's not quite as easy to work with or as prolific in the breeding department.

Two common tropical species are Blue Worms (*Perionyx sp*) and African Nightcrawlers (*Eudrilus eugeniae*). Because of their cool-temperature-intolerance (will often start dying when temps drop below 10 C / 50 F), I don't recommend them for most outdoor vermicomposting systems. But if you do happen to live in a semi-tropical or tropical environment they probably can't be beat for waste processing and fast population growth!

IMPORTANT NOTE: Blue Worms are a common "pest worm" on worm farms in warmer regions – and can even completely take over Red Worm beds. As such, it is not uncommon at all to end up with at least some of these worms when ordering from suppliers in warmer parts of USA (very widespread in Asia as well). Uncle Jim's, in particular, has a reputation for selling a lot of these worms as "Red Worms". They are great composting worms – don't get me wrong – but like I said, they don't tolerate cool conditions. They also tend to roam a *lot* more than Red Worms.

Look for fast, almost jerky movement, a thinner body (maybe with a blue sheen) – almost "pointy" on both ends - and a clitellum up closer to the anterior end (Red Worms have a thicker "head" region with a clitellum that is further back).

Semi-Epigeic Worms – There are various earthworms that are kind of "in-betweeners", sometimes referred to as epi-endogeic, or endo-epigeic, that can make their presence known in your yard. Common examples include various "jumper" worms (*Amynthas sp*) and another "Red Worm", *Lumbricus rubellus*. If these worms happen to be in your area (eg. both worms have become widespread in North America. and various other parts of the world) they can likely be beneficial – but you should never actually stock these worms on purpose.

Some wonder how to tell *L. rubellus* apart from *Eisenia* Red Worms. This is actually very easy once you get the hang of it. All *Lumbricus* worms (Canadian Nightcrawlers included) have a flattened tail tip – sometimes called a "beaver tail". Body coloration in *Lumbricus* worms is paler (often somewhat translucent - especially in young worms like the one below), with no banding pattern.

Eisenia worms tend to have a much more distinct banding pattern (although this can vary quite a bit), and more vibrant colors – usually with oranges and yellows. As you can see in the next image, the tail tip of *Eisenia fetida/andrei* is more conical in shape (not flattened) with some obvious yellow coloration.

If you end up with *L rubellus* in a vermicomposting system, it is very common for them to end up sitting up at the surface (if they don't really have good options for burrowing down) since they are not nearly as tolerant of warm conditions as the composting species. They can be common in and around outdoor beds early and late in the season – especially if you are using a lot of leaves – but they will tend to vanish during warmer times of year.

Moving on...

No discussion of outdoor vermicomposting should be without at least a mention of to the topic of "invasive earthworms"...

It is important to bring this up since invasive worms have indeed been causing some issues in North America. The most common scenario involves non-native worms being introduced (eg bait getting dumped by fishermen) to habitats where there are few or no earthworms found. The worst offenders are the litter worms like *L. rubellus* and the jumpers since their voracious appetite for leaf litter can result in the loss of important habitat for other wildlife.

What's unfortunate is that this has ended up becoming a bit of a "tossing the baby with the bathwater" situation, with composting worms often being lumped in with these other offenders. Yet (*Eisenia*) Red Worms pose zero threat. They are specialized for life in really rich habitats like compost heaps and manure piles (and vermi-trenches) – NOT leaf litter! There is a big difference between being able to *survive* and actually *thriving* to the point of taking over the habitat. Similar idea as what I was talking about earlier about putting composting worms in soil.

Bottom-line, this is not something you should be concerned about if you are thinking about adding composting worms to a backyard system. The worms will be more than happy to stay in the zones where you are adding rich organic wastes.

If you feel like you still want to learn more about the topic of invasive earthworms, here is an article I wrote about it a number of years ago:

"Do Composting Worms Pose a Threat as Invasive Species?"

OK – let's now look at the needs and hazards associated with composting worms!

Key Requirements of Composting Worms

1) **Moisture** – worms are largely made up of water and they need to stay moist in order to facilitate gas exchange (respiration) with their surrounding environment. Moisture is also vitally important for microbes that play such an important role in the vermicomposting process. That said, too much moisture can lead to problems, such as a lack of...

2) **Oxygen** – composting worms (and earthworms in general) are fairly tolerant of low oxygen, but it is still vitally important for their survival, and for the speed/quality of the vermicomposting process. As I just alluded to

(in moisture section) oxygen and moisture tend to be somewhat inversely proportional, so you need to be careful about providing "too much" of either (too much aeration dries out the system – too much moisture reduces oxygen levels). When a system has sufficient oxygen levels it tends to have a nice earthy smell (although some wastes do give off unpleasant odors when breaking down regardless of O2 levels).

3) **Warmth** – generally speaking, the best temperatures for most composting worms are going to be somewhere between 15 and 30 C (59 and 86 F), with 25 C (77 F) often cited as an "ideal" temperature in the academic literature. Warm conditions also help to stimulate microbial activity.

4) **Darkness** – light can stress worms (best case scenario) or even kill them (in the case of sunlight), so make sure you keep your systems dark. Any container used as a worm bin should be opaque (or at least should block a lot of the light – NOT be completely transparent), and open systems should always have a thick layer of cover bedding over top.

5) **Habitat/Food** – worms need a place to live – habitat "structure" - along with a source of nutrition. I've grouped these together since they are often one and the same – even the materials we label as "bedding" will tend to become a form of food over time. Good habitat materials tend to have a high C:N, hold moisture well, and be fairly resistant to break down – and a bulky structure can be beneficial for air flow (eg. shredded cardboard). Many new vermicomposters make the mistake of using too little bedding and too much food – when it should actually be the other way around (moderate amounts of food in a bedding-rich system can sustain the worms for a very long time, assuming all other requirements are met).

6) **"Peace and Quiet"** – yes, I realize that sounds a bit silly! Basically what I'm getting at is the fact that composting worms work best when they aren't constantly being disturbed. Set up their system away from vibration sources (don't put your indoor bins on your washing machine, for example), and try to resist the temptation to *constantly* be digging around (although some worms are more tolerant of this than others). That being said, I don't want to scare people off from spending time observing what's going on in their systems – this can be important as well! Just try to avoid becoming an over-attentive "worm mama/papa".

Things That Can Harm or Kill Your Worms

1) **Excessive drying** – hot/dry conditions and lack of moisture in a well ventilated system can lead to conditions that are unfavorable for worms, microbes and the vermicomposting process in general. Composting worms are fairly well-adapted to dealing with moisture loss (producing cocoons, shrinking in size etc), especially if it happens gradually over time – but it's very important to keep an eye on this, especially if you are in a location with low air humidity.

2) **Overheating** – once temps in a system get up past 32 or 33 C (90-ish F), composting worms – and yes, even tropical species – can start to get stressed, and if there is no way for them to move to cooler zones or escape, they may end up dying. The 3 main sources of heating are 1) hot ambient temps, 2) solar radiation, and microbial heating. If you live in a location where ambient temps regularly get up above 90 F you may have your work cut out for you – but the good news is that various strategies (such as use of trenches/pits, along with lots of cover materials) can greatly assist your efforts. Use of smaller plastic "worm bins" outdoors during warmer times of year should be avoided entirely.

3) **Cold Temps** – as touched on earlier, the main tropical species - Blue Worms and African Nightcrawlers - will start to die off as temps drop below ~10 C (50 F) or so. Red Worms and European Nightcrawlers are quite cold-hardy but should not be allowed to reach the freezing mark or below. Even if your worms are able to survive the cold, it's important to realize that the process itself can slow down a *lot* once temps start to dip down below 15 C (59 F).

4) **Ammonia gas production** – low C:N ratio of waste materials (~ 20:1 and below) can lead to off-gassing of ammonia, which can kill worms in a hurry. Be very careful with materials such fresh grass clippings, fresh manure (and certain kinds of manure such as from poultry), and protein-rich wastes. Air flow is very important, and use of "Living Materials" (more info further along) can be beneficial for

filtering out ammonia and other harmful compounds.

5) **Anaerobic conditions** – we talked about the importance of oxygen earlier. When levels get too low – due to poor air flow, high moisture levels etc - you can end up with anaerobic conditions. There are plenty of times the worms can do just fine in pretty swampy conditions (even if the vermicomposting process itself ends up hampered a lot), but when you have a lot of rich wastes in a system this can get quite dangerous. Fermentation processes, for example, can produce harmful alcohols, acids etc – and can be quite common when too much food waste is added at once. Moisture in completely enclosed systems (especially those made out of plastic) needs to be monitored very carefully – and balanced with absorbent, bulky bedding and good air flow. NOTE: The "smell test" is just about the easiest way to determine if conditions are anaerobic (if the bin stinks – very good chance this is the problem)

6) **Inorganic salts and harsh chemicals** – a worm's skin is a highly sensitive (and vitally important) organ. Avoid use of bagged potting soils (since often come with starter fertilizer), urine-soaked manure/bedding (leave it exposed to elements for awhile), and any materials containing pesticide residues or other harsh chemicals in general. Even wood ash from your fireplace can potentially cause trouble since it forms potassium hydroxide ("lye") when mixed with water.

7) **Sunlight –** careful with excessive handling of worms (outdoors) on hot, sunny, summer days.

8) **Predators** – typically only a potential issue with outdoor systems – primarily those with direct contact with the soil, or at least those offering "easy access" options. Some examples include: moles, shrews, robins, and predatory flatworms (last one will likely only be a potential threat in warmer locations). I myself have had to deal with robins and shrews – while they can both be a bit frustrating, they actually haven't really had a significant impact on my outdoor worm population. The funny (and ironic) thing is that new vermicomposters tend to worry so much about other organisms harming their worms, when in fact they themselves have the highest chance of killing their them off! (bottom-line – don't obsess about

other critters as much as you obsess about meeting the needs of the worms!)

Optimization

A good rule of thumb for increasing your chances of success with vermicomposting is to do your best to provide as close to "ideal" conditions for your composting worms (and microbes) as you possibly can. This is what I refer to as "optimization" - and it probably sounds super obvious and "common sense", but rest assured, it's something not nearly enough vermicomposters take all that seriously.

Below are some of the KEY areas to focus on:

Temperature – 20-30 C (68-86 F)

Moisture/Oxygen Balance – Nice and moist, yet still oxygenated (avoid swampy conditions, especially when there are rich wastes present – foul smells are usually a good indication of anaerobic conditions)

Habitat/Food – the worms need a safe habitat *and* a good source of nutrition. There are certain materials that can provide both, but for the average home vermicomposter, this normally requires plenty of carbon-rich bedding "bedding" types of materials with moderate amounts of kitchen scraps or other rich wastes as the food.

Step #1 when starting out should *always* be the establishment of a safe habitat for the worms. Once this is established, you don't need to be quite so careful about what gets added (especially with larger outdoor systems) because the worms have a safe place to hang out in if what you are adding isn't yet worm-ready.

Start with mostly (moistened) bedding materials – shredded corrugated cardboard is likely my favorite, but there are plenty of other paper wastes (newsprint, brown paper – even shredded office paper if you soak and drain it) that work well. A lot of people use peat moss or coconut coir – I personally don't like working with either one. They both consist of very small particles, so don't support good air flow – they also both usually need some preparation in

order to be ready for use. Peat moss is difficult to wet and is acidic, and coir can contain salts etc that can be harmful for the worms. If prepped properly I would consider these to be an excellent secondary bedding, since they do hold water really well – but my recommendation would be to mix them with something bulky like the shredded cardboard.

"Living Materials" are another type of habitat material I highly recommend, and they can greatly assist with the optimization process – but there are definitely more nuances in comparison to typical bedding, so I tend to be a bit cautious about recommending them to newcomers (they also tend not to be quite as readily available). A good place to start is with my Living Material Guide. And please don't hesitate to e-mail me if you have any questions about the topic.

Optimization of food materials can greatly assist the worms (and microbes) as well. Freezing/thawing fruit and veggie scraps, for example, helps to start the physical break-down of the wastes making them more prone to microbial attack (also has the added bonus of killing fruit fly eggs, which can sometimes already be in fruit peels). Chopping up wastes really well increases the surface area (exponentially) for microbial attack – and mixing in some "Living Material" (again, be sure to refer to the guide I linked to above) is a great way to introduce large numbers of these aerobic decomposer microbes, helping to kick-start the process.

As the microbes start breaking down the wastes, they become much more "worm-friendly" (keep in mind, the worms don't have teeth – they are basically like living vacuums coming along and slurping up a slurry soft, wet materials along with countless microbes).

Insurance Systems

Before I wrap things up I do one to spend a bit of time talking about my "Insurance System" (or "Insurance Bin") concept.

Regardless of how carefully we tend to the needs of our worms – or even how many years of experience we end up with – things can (and will) still go wrong. Especially with outdoor systems in locations with climate extremes. So, it can be very valuable to have multiple cultures of composting worms going at any given time – some in a safe, climate-controlled environment.

Lots of people are fine with indoor vermicomposting – and just naturally end up with multiple indoor systems on the go (in these cases, Insurance Bins probably aren't needed) – but there are plenty of others who don't want to keep a system indoors for various reasons, or who don't want to rock the boat because significant others are making a fuss.

An Insurance Bin (when set up properly) offers the best of both worlds. It is a very low-maintenance, hassle-free system that allows you to keep a culture of composting worms (ideally Red Worms) going for months at a time. It is particularly valuable for brand new vermicomposters setting up outdoor systems for the first time, and pretty well anyone attempting outdoor vermicomposting in a region with climate extremes for at least part of the year.

You could literally put one of these bins on a shelf in a closet and basically "forget" about it. I also happen to believe this approach is a great way to show people (*and* their significant others - lol) that indoor vermicomposting can indeed be hassle-free.

To learn more, be sure to check out this blog post: The Insurance Bin
(It links to future updates as well)

Obviously, there is plenty more that could be said about composting worms and the vermicomposting process as a whole. But even just the information I've shared in this tiny guide - if learned and applied - should be enough to greatly increase your chances of success.

As always, don't hesitate to let me know if you have any questions along the way.

Your friend (with worms),

Bentley "Compost Guy" Christie