

green
calgary

Vermi-Composting Guide



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This guide is divided into two parts. Part I, the Basic Guide, provides novice compost enthusiasts with the basic information and helpful advice needed to begin worm composting and to avoid the most common mistakes that might discourage them from doing more. Part II, More Detailed Information, provides additional material about specific topics, including types of vermicomposting worms; building a worm bin; soil and compost; and compost tea.

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PART 1 - BASIC GUIDE

Worm compost

What is worm compost?

Also known as vermicompost, it consists of worm casting (worm poop), composted bedding, uneaten food, and living microorganisms such as bacteria.

Matured or finished compost is an organic soil additive that is mixed with garden soil to build up its nutrient content, moisture-holding capacity, and improve its texture.

How is worm compost made?

Worms are needed to ingest food that they excrete as vermicast (worm poop). Red wigglers and/or European night crawlers are the most commonly used worms in vermicomposting.

How do worms make compost?

According to one expert, “Worms eat decaying vegetation and excrete organic compounds that enrich the mix, while burrowing helps aerate the compost. As organic matter is passed through a worm’s digestive system, it is finely ground and neutralized by calcium carbonate that is secreted in the worm’s gizzard” (Thompson, 2007, p. 23).

The worms can be kept in a wormery, bins, and other containers where they convert organic waste into vermicompost.

Some worms, such as the burrowing common earthworm, can also be found outdoors depending on conditions. You can even find worms under heaps of rotting animal manure.

How is worm compost used?

As an organic soil additive, worm compost can be mixed with garden soil, usually in early spring and late fall. Compost, in general, replenishes many of the nutrients consumed by plants during the growing season. These nutrients and water are taken up by the plants through their roots with the help of microorganisms and fungi that thrive when the soil is healthy. The healthier the soil, the healthier the plants. Healthy plants are more resistant to disease, have greater yield, are more nutritious, and often taste better.

The amount of compost that is added to the soil will depend on its condition. Hard soils and those with a high clay content call for more compost and other organic matter. It may take several growing seasons for poor soil to gradually improve and produce better crops. Think of adding

compost and other organic materials to the soil every year as a long-term investment that will pay off increasing returns over time.

What do you need to make worm compost at home?

- Worms
- Bin(s) / container(s)
- Bedding
- Food
- Moisture
- Air and the right temperature

Worms used in composting

- Red wiggler (*Eisenia foetida* and *Lumbricus rubellus*)
- European night crawler (*Eisenia hortensis*)
- Other species, such as the African nightcrawler (*Eudrilus eugeniae*)

Worm bins

Worm bins are to be used indoors. Place the bins away from heavy traffic, vibrations (not on top of the clothes dryer, for example) and from pets.

A bin serves to contain the entire vermicomposting operation (bedding, worms and food). Worm bins must meet three basic criteria whether you choose to buy one or build your own:

- Be made out of a dark material. Worms do not like light.
- Have a lid. Keeps children and unwanted pests such as fruit flies out.
- Have air holes (on the upper part of the bin and lid). Provides good ventilation but also maintains moisture.

Types of bins

Many people choose to make their own worm bin out of a plastic container. Both hard and soft plastic are suitable for this purpose; just be sure to add air holes. If you choose to make your own bin, go for wider rather than deeper.

Others choose to purchase a bin. Green Calgary sells an in-store made vermi bin which is perfect for vermicomposting in Calgary.

Worm towers. These are bins stacked one over another to form a multi-level tower. Holes in the bottom of some bins permit the worms to move up to the next bin

in search of food allowing the finished vermicompost on the lower levels to be easily harvested as a soil amendment.

Worm bedding

Worm bedding is the top layer of what’s inside a bin and provides a variety of functions including:

Controls moisture level: If your bin is too dry, add moist bedding or if it is too wet, add dry bedding.

Provides extra food if needed: If you forget to feed your worms or go on vacation, bedding is a back up food source.

For breeding: Gives a nice environment for procreation.

To contain smell, if any: Sits on top of the organic matter in the bin providing a layer between it and your home.

Shredded paper and cardboard: Green Calgary believes shredded newspaper is the BEST bedding material. Newspapers are printed with vegetable based ink and will not harm worms. Do not use bleached paper or paper with chemical based ink. Cardboard egg containers can be moistened with plain water and torn to small pieces.

Potting soil: A small amount of ordinary garden soil sprinkled on the bedding will be ingested into the worms’ gizzard and help them digest their food.

Shredded pesticide-free leaves: Well-rotted and sterilized animal manures. These are usually used by vermicomposters who sell their finished casting products. Don’t use glossy paper, cardboard, and magazines, credit card bills, treated plant waste and topsoil, or any material with salts, ammonia, glue, and other chemicals that may harm the worms.

Peat moss: Some people use sphagnum peat moss. Because peat moss is a non-renewable resource, we do not recommend its use.

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Worm Food

Acceptable worm food

- Fruit and vegetable waste.
- Egg shells
- Coffee grounds (in moderation) and tea leaves
- Aged (composted) cow, horse, or sheep manure
- Microorganisms that are in the vermicompost

Not recommended

- Meat, fish, bones, and dairy products
- Oily or greasy foods, ie: salads with oily dressing
- Highly acidic and spicy food, ie: citrus
- Pet waste
- Bones, cherry pits, onions & ginger

Recommended method of preparing and giving food to worms

- Chop into small pieces to accelerate decomposition
- The smaller the pieces, the faster they will be processed
- Rinse, air dry, and crush or pulverize egg shells before giving to worms.
- Puree and freeze food in small containers for storage
- Ration small quantities and observe rate of consumption
- Give them less food if there is uneaten food visible after one week.
- Increase the amount of food as the worm population grows. Do not overfeed
- Always feed the worms under the bedding materials, never on top

Freezing kills unwanted fruit fly eggs and larvae.

Moisture

- » Use a spray bottle to water or moisten the bedding.
- » Much of the moisture will be from the fruits and vegetables.
- » If the bedding dries too rapidly, spritz the bin with dechlorinated water.



Air and temperature

- » Ventilation holes or vents are important to allow air to circulate.
- » Worms need air to breathe or else they will suffocate and die.
- » Worms can drown when confined under water or in water-saturated soil.
- » If excess water collects in the bottom of the bin, remove it with a baster or soak it up with shredded newspaper.

Temperature

- » Worms do well indoors provided that they have enough air, moisture, bedding and food in their bin.
- » The temperature range tolerated by red wigglers is around 5 to 27 degrees Celsius (40 to 80 degrees Fahrenheit). However, they are most active between 13 and 25 degrees Celsius (55 to 70 degrees Fahrenheit). Worms will not survive freezing nor will they tolerate high ambient temperatures.

Harvesting compost

- » Use light to harvest – easiest method.

- » Use the red wiggler's aversion to light to your benefit. For best results, don't feed the worms for at least two weeks before starting, allowing all unprocessed food to be fully processed.
- » When you are ready, remove the top layer of unprocessed bedding and place it to the side. Spread out a tarp or plastic sheet. Dump out the worm bin contents and create small mounds over the entire tarp.
- » Leave it to sit in the sun or under light for twenty to sixty minutes. Worms will migrate towards the bottom of the piles to avoid the light.
- » Scrape the top layer of castings off, returning uneaten food and bedding to the worm box.
- » When you are down to a pile of worms, place them back in the bin and move onto the next pile.

Partition method

- » When your bin is about $\frac{3}{4}$ full, move the contents of your bin to one side (usually will be $\frac{3}{4}$ of the bin and $\frac{1}{4}$ will be empty) and place a piece of cardboard in the bin to separate the two sides. In the newly created and empty space, place food and bedding.

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Essentially, you have built a new bin on $\frac{1}{4}$ of your existing bin. Feed the worms only in this new area.

- » Over the course of a few months the old side will be totally processed and ready to harvest. All or most of the worms will have moved to the new area where food and bedding are available. To ease your harvesting process, leave the lid of the worm bin off and exposed to light for about an hour to encourage the remaining worms to move out of the finished vermicompost.

Mechanical separator

- » These are hand-cranked or motor driven tumblers that allow larger volumes of worm compost to be sifted efficiently.
- » Videos of how they are made and operated are available on the Internet.
- » Commercial worm growers, who sell their compost to gardeners and the worms to fishermen, are the typical users of these devices.

Trouble-shooting fruit flies and other pests

- » To minimize fly infestation, fruit and vegetable waste should be collected in sealed containers. Store them in your freezer to kill any fruit fly larvae and facilitate the breakdown of the plant cell walls. Thaw the frozen food to room temperature before putting it in the worm bin.
- » Some worm enthusiasts puree their fruit and vegetable waste using a blender before feeding the worms. Freeze the paste in container are then stored for future rationing to the worms. This method is claimed to help

reduce fly infestation as well as avoid over-feeding the worms.

- » Use fruit fly traps. Make several using baby food bottles half-filled with apple cider vinegar and covered with perforated plastic held tightly with rubber bands. Put one trap inside each bin, and several outside. Green Calgary also sells a 'Fruit Fly Trap' developed by the Ontario Insect Control Board.
- » Expect many species of macro- and micro-organisms to cohabit the worm bin. Many may not pose a threat to the worms and may even help in decomposing the food and be part of the worm's diet.

Smell

A well balanced and well maintained worm bin will simply give off an "earthy" smell not typically noticeable except when the lid is open.

Putrid odor comes from compost bins in which there is too much nitrogen-rich organic material ("greens"), too much moisture, and not enough carbon-rich material ("browns") and air circulation. In addition to the nitrogen-carbon imbalance, it could also be because there is too much food for the worms to consume.

- » The solution is to avoid giving the worms food for a few days or even weeks until they finish the uneaten food.
- » The foul odor may also be caused by the presence of rotting meat, fish, or dairy products.
- » Remove these immediately and avoid adding them in future.
- » Add fresh bedding to absorb any liquid that may have accumulated in the bottom of the bin.
- » Airing the bedding will help keep it from going anaerobic.
- » If necessary, drill more holes in the bin to allow greater air circulation.

Escapeses

- » Worms are unlikely to leave a balanced habitat that offers adequate moisture, food, air, and protection from predators, toxins, light, and extreme temperature.
- » By keeping their habitat in a healthy and optimal condition, the worms should thrive, reproduce, and live their lives in harmony with the other residents of their worm bins.
- » Worms avoid light. They will remain under or inside their bedding where it is dark. They are unlikely to sneak out where they may be exposed to light, predators, and drier air. Besides, where would they escape to that's better than their bin?

Die off

- » Monitor the worm bin and observe its residents at least once every week or two. A declining population is a bad sign. Healthy worms should also be actively feeding, mating, or laying cocoons.
- » Entire populations of worms can die in an environmentally unfriendly and/or toxic worm bin where they are forcibly confined. Are you overfeeding them? Have you harvested the vermicompost and/or replenished their bedding? Do they get sufficient air and moisture?
- » If the population of worms gets too high, some may die off (natural population control). Alternatively, give some of the worms to a friend to start a new bin, or add them to a backyard composter or garden (although they will not survive the winter).

Green Calgary provides all you need to get started. You can purchase just your worms (pre-order only), bin options and a definitive book to get started. Learn more on our website or call or email us for more information. 403.230.1443 ext. 222 or products@greencalgary.org

Green Calgary sells Red Wigglers by the half and full pound. Pre-orders required.

Vermicomposting worms

- » There are several worms that may be used in vermicomposting. This Guide only focuses on two: Red Wigglers (*E. foetida*) with European Nightcrawlers (*E. hortenses*).
- » *E. foetida*, also known as Red Wigglers, are the most common species used for making compost.
- » Red wigglers are more prolific, grow faster, and more tolerant of wider range temperature changes than *E. hortenses*.
- » Both will not survive bitter cold winters if kept outdoors because, unlike burrowing earthworms, they stay close to the surface just beneath their bedding and food source.
- » *E. hortenses*, or European Nightcrawlers, are also called Carolina night crawlers, Jumbo red worms, Trout worms, Panfish worms, Leaf worms, and Giant red worms.
- » They require environments that are moister than *E. foetida*'s bin. *E. hortenses* are surface-dwelling and have poor burrowing capacity. Used as bait worms and for composting.
- » Compared to red wigglers, they are larger (can grow up to 12 cm long), slower to reproduce, and are voracious feeders.
- » *E. hortenses* are less tolerant of extreme temperatures. If unsure, keep the worm bins indoors to avoid extreme temperatures.
- » *E. hortenses* can tolerate slightly acidic medium. Overfeeding sometimes makes the worm bin acidic.
- » *E. hortenses* have a longer reproduction cycle and lower reproduction rate than *E. foetida*. Although not as prolific *E. hortenses* grow very rapidly in size.

- » *E. hortenses* produce more compost and better (finer) quality vermicast than *E. foetida*.
- » *E. hortenses* are probably of east-Mediterranean origin. They are widely distributed throughout central and western Europe, where they are used mostly for vermicomposting. In North America, they are mainly used as fish bait and secondarily for vermiculture.
- » There is disagreement about *E. hortenses*' relative value in producing compost but there's lots of consensus about their value as fish bait, primarily because of their larger size, tougher skin, and other characteristics that appeal to sports fishermen.
- » *E. hortenses* may be raised with *E. foetida* in the same bin and will prefer areas that are more moist, usually the bottom of the bin.
- » Worms are sensitive to salts and ammonia. Avoid using fresh poultry litter as bedding.
- » Worms in overcrowded bins tend to be smaller and grow more slowly than worms in less densely populated containers. To control population density, create new bins and split the worm population between the old and the new bins. You can also share your surplus worm with friends and schools that wish to try worm composting.

Soil and compost

- » Compost is an effective soil amendment. To understand why, it is important to know a little bit about what soil is about and how it benefits from compost. To a gardener, the most important thing to know is how plants benefit from healthy soil.
- » Soil is made up of four main components: rock or mineral particles, organic matter, air and water.
- » Rock and mineral make up roughly 90% of the soil, while the other 10% is comprised of organic matter. Although only comprising 10% of soil, the importance of organic matter cannot be understated. It is organic matter – the various stages of decomposing

plant residues, leaves, animal manure, et cetera – that makes the soil work. Without it, a soil will quickly deteriorate, and unhealthy soil creates unhealthy plants and people.

- » The rock and mineral component is comprised of silt, sand and clay. All soils have varying proportions, influencing the soil's ability to retain water, nutrients and air. Any extreme is undesirable. Sandy soils are prone to rapid drainage and nutrient loss, while soils high in clay suffer from poor drainage, excluding air, water and thus, nutrients. A good soil has equal parts of silt, sand and clay, often referred to as loam. In an ideal soil, the silt, sand and clay particles are grouped together with organic matter to form large particles called aggregates.
- » Healthy soil contains a living community of micro and macro-organisms such as mold, bacteria, fungi, beetle mites (tiny round red mites), springtails (oblong white creatures), and white worms (almost transparent 1 cm long worms).
- » What happens when compost is added to soil?
- » The soil's capacity to retain water improves, making it unnecessary to water the garden as frequently.
- » The soil's nutrients are replenished, especially the organic nutrients that are derived from nitrogen and carbon.
- » Plants that grow in soil rich in nutrients will thrive, yield more abundantly, and be more resistant to disease. They will also protect the soil from erosion from wind and water.

Building a worm bin

- » Some prefer to build their own worm bins out of recycled materials such as plastic bins. Check the internet for instructions.
- » Choose wider and shallower rather than deeper containers, such as a Rubbermaid Roughneck storage bin. Either a 3-gal box that measures 15.8"L, 10.3"W, and 7"H or a 10-gal box that is 23.9"H, 15.9"W, and 8.7"H will be good options.

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- » If building a wooden bin, make it 8-12" deep (and no deeper than 18").
- » Use plastic bins that are opaque (not transparent or translucent) in order to keep light from entering the bin.
- » Select bins that have lids to keep insects, predators (ie. pets, raccoons), and young children from rooting around the bin.
- » Drill small holes near the top and in the lid to allow air to circulate.
- » Wooden bins have the advantage of being more porous, therefore allowing more air into the bin. Worms breathe oxygen so this helps. But this also causes the bedding to dry out faster than bedding in plastic bins.
- » Wood also offers better insulation than plastic. However, because the worms must be kept in a moist and humid environment, plastic is more resistant to rotting than wood. Wooden bins can also be heavier than plastic bins.

Compost tea

Compost tea is a liquid extract made when a small bag of finished compost (not fresh manure) is steeped or "brewed" for a several days in 5 gallons of de-chlorinated water treated with some seaweed, fish emulsion, or molasses as food for the microbes. The purpose of brewing a bag of compost is to release the bacteria and fungi from the compost into the water. Air is bubbled through the liquid mixture with an oxygen pump for 2-3 days. It is then applied to the plant as a foliar fertilizer. The mixture is usually filtered before applying the liquid as a spray.

Proponents of the use of compost tea claim that this organic liquid fertilizer can help increase:

- yield of vegetable plants
- quality/taste of fruits and vegetables
- resistance to harmful pathogens
- pest resistance
- weed resistance
- soil's water-retaining property

The live "good" microbes form part of the biofilm that is sprayed on leaves and fruits. They compete with the "bad" microbes for space on leaves and fruits that they would otherwise occupy. Compost tea is said to be a source of plant nutrients, such as nitrogen, potassium, and other minerals, that can be taken up by the plant through its leaves and roots.

There are different recipes to making compost tea. Some are fungal-dominated because they feed fungi. Some are bacterial-dominated, and some are balanced. We are not aware of which is better.

Because plants do not take up all of the tea, there is some concern that some of it will leach into the ground water and contribute to eutrophication.

Although there are numerous subjective testimonials about the merits of compost tea, there is scant experimental evidence to definitively demonstrate its effectiveness. Researchers (e.g., Linda Chalker-Scott) from the Washington State University's Puyallup Research and Extension Center found that the claims have little scientific basis.

References

- Appelhof, M. (1997). Worms Eat My Garbage. Kalamazoo, Mich: Flower Press.**
- Chalker-Scott, L. The myth of compost tea revisited.**
- Thompson, Ken (2007). Compost: The Natural Way to Make Food for Your Garden. New York: DK Publishing.**

Worms Love Leftovers

Green Calgary offers this school presentation to give children a peek into the amazing world of worms and how they help recycle organic waste, turning it into healthy living soil.

For info on the Green Kids programs and a Helpdesk to answer your composting questions call: 403.230.1443 ext 222.

greencalgary.org

Further reading

Compost

Clare Foster, Cassell Illustrated, Great Britain, 2002

Compost This Book! The Art Of Composting For Your Yard, Your Community, And The Planet

Tom Christopher and Marty Asher, Sierra Club. 1994

Easy Compost: The Secret To Great Soil And Spectacular Plants

Beth Hanson, Brooklyn Botanic Garden Publications. 1997

Let it Rot! the gardener's guide to composting

Stu Campbell, Storey Communications, Inc. 1990.

Rodale Book of Composting

Deborah L. Martin and Grace Gershuny, editors, St. Martin's Press, New York, NY, 1992

The Real Dirt: the complete guide to backyard, balcony and apartment composting

Mark Cullen and Lorraine Johnson, Penguin Books USA Inc., New York, NY, 1992

Organic Gardener's Composting

Steve Solomon. Available as a free download from the Soil and Health Library, at soilandhealth.org.

The Intelligent Gardener: Growing nutrient-dense food

Steve Solomon with Erica Reinheimer, New Society Publisher, Gabriola Island, BC, Canada, 2013

Compost: The natural way to make food for your garden

Ken Thompson, DK Publishing, New York, NY, 2007

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