

Vermicomposting

with Some Suggestions for Dry Climates



In Partial Completion of the Requirements for the
Bernalillo County Extension Master Composters' Training Program
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Introduction to Vermicomposting

- ***Vermicomposting*** (a.k.a. ***Vermiculture***) is, simply put, composting with worms
- ***Vermicompost*** is the product of the composting process comprising of (1) worms, (2) microbes, and (3) other critters, to create a heterogeneous mixture of decomposing vegetable or food waste, bedding materials, and ***vermicastings*** (a.k.a. ***castings, worm poop***).
- Vermicomposting is an *aerobic* process – it requires oxygen. An anaerobic environment would kill most worms.

Why Vermicompost?

- 1) Composting worms are fun & educational
- 2) Inexpensive hobby to get into
- 3) Inexpensive to maintain
- 4) No size requirement; you can start out small
- 5) Convenient for any home-owner or apartment-dweller
- 6) Worms can be raised inside or outside your home, though outside requires more preparation for weather extremes as well as predators
- 7) Worms will survive in their bin (& even thrive) if not fed for many weeks, so business travel, vacations, & hectic schedules are okay

Why Vermicompost? (cont.)

- 8) Feed your worms kitchen & yard wastes, rather than sending that waste to a land fill
- 9) Vermicompost is a nutrient-rich type of compost (better than regular compost) & an excellent fertilizer for your plants (see table on next slide)
- 10) The enzymes produced by the bacteria in a worm's digestive system unlock many of the chemical bonds of the organic matter to create plant-available nutrients (chelation)
- 11) Vermicompost contains potent growth-promoting compounds for plants
- 12) Vermicompost can help protect plants from diseases
- 13) Helps reduce the use of chemical fertilizers

Some of the Chemical Characteristics of Typical Garden Compost vs. Vermicompost

(Source: New Mexico State University, Guide H-164)

Parameter	Garden compost ¹	Vermicompost ²
pH	7.80	6.80
Total Kjeldahl nitrogen (%) ³	0.80	1.94
Nitrate nitrogen (ppm) ⁴	156.50	902.20
Phosphorous (%)	0.35	0.475
Potassium (%)	0.48	0.70
Calcium (%)	2.27	4.40
Sodium (%)	<0.01	0.02
Manganese (ppm)	414	475
Copper (ppm)	17	27
Boron (ppm)	25	34

¹Sample from Albuquerque, NM

²Sample from Tijeras, NM

³Kjeldahl nitrogen = total percentage of nitrogen in sample, including organic matter

⁴Nitrate nitrogen = nitrogen that is immediately available for plant uptake by the roots

Why Vermicompost? (cont.)

- 14) Vermicomposting can be a great home business
- Selling worms for others to use in vermicomposting
 - Selling vermicompost to gardeners
 - Selling vermicompost tea to gardeners
 - Selling worms for fishing bait
 - Selling worms for feeding small animals or exotic pets



Three Major Components

Structure
(worm bin)



Habitat/
Food



Worms,
Microbes,
other Critters



Best Worms for Vermiculture

Most commonly used composting worm is *Eisenia fetida*, a.k.a. *red wigglers*, red worms, manure worms, tiger worms

- Red wigglers often found in aged manure piles or in a composting environment
- Red wigglers are small worms (2" - 4") weighing about .5 or .6 grams each. Just hatched red worms are about ½" long and may be whitish, transparent, or beige.
- Red wigglers are more temperature-tolerant than other worms:
55° ≤ optimal waste processing & reproduction ≤ 78° F
40° ≤ worms & egg cocoons will survive ≤ 90° F
32° ≤ worms & egg cocoons will likely survive ≤ 40° F
??° ≤ egg cocoons will likely survive ≤ 32° F
- Putting red wigglers in regular garden soil will KILL THEM.
- Typical garden earthworms do well in 10% compost, 90% soil
Red wigglers do well in 90% compost, 10% soil
- Red wigglers do not burrow – they generally live in top 6" or 8" of their habitat
- pH of red wiggler habitat should be between 5 and 9

Key Requirements for Worm Health

(Source: “A Guide to Vermicomposting” by Bentley Christie)

- ***Moisture*** Bedding moisture 80 – 90% is ideal for red wigglers; 50 – 90% is probably okay
- ***Air*** Oxygen critical; but moisture & air are inversely proportional
- ***Warmth*** Warmth in winter; coolness in summer
- ***Darkness*** Worms are VERY sensitive to light, especially sun light
- ***Habitat/food*** See next sections
- ***Peace & quiet*** Do not disturb frequently; no constant vibrations

Your Vermicomposting Structure (e.g., Worm Bin)

- Plastic bins are okay, provided you prevent the worm bedding from getting soggy at the bottom. Wood is better as it “breathes” as well as insulates the contents. But using plastic bins is how 99% of vermicomposters start out.
- A larger surface area is more important for red wigglers but the bin does not need to be overly deep
- **Mary Appelhof's 1-2-3 Portable Worm Bin (1' deep, 2' wide, and 3' long).** (This size bin works best for homes, apartments and classrooms. They are easy to tuck under a desk, place below kitchen sink, hide in the laundry room, or move when needed. This size is also portable.)
- When a worm box is used outside year-round, no bottom is necessary. (You may want to line the bottom with rocks or boards to keep rodents and other worm-loving creatures from tunneling in. However, if the bin has a bottom, it can be moved into a heated garage or basement during cold weather.)
- A bin must be opaque with no light penetrating into the worm bedding
- A vermicomposting structure does NOT have to be a bin – it could be a hole or trench in the ground, or even a pile or windrows above ground.

Your Worm Bin (cont.)

- Worms can escape from most bins if they really want to or need to (keep a light on over open bin to discourage new worms from migrating or you may need to investigate the bin in case there is a noxious gas buildup)
- Most bins will need to be covered to conserve moisture and provide darkness for the worms. In an arid climate, it helps to cover the top surface of your habitat with a thick layer (4-6") of dry bedding materials or use burlap, etc. which will help conserve moisture, provide darkness for the worms, and may help discourage flies, fruit flies, rodents, etc.
- For outdoor applications, a solid lid is important to keep out vermin and other predators as well as keeping a heavy rain from soaking the contents overly.
- For plastic bins, drill 10 to 20 holes (1/4 - 1/2 inches) in the bottom for aeration and drainage and another 20+ holes in the lid. (A plastic bin may need more drainage -- if contents stay too wet, drill more holes. Raise the bin on bricks or wooden blocks, and place a tray underneath to capture excess liquid which can be used as liquid plant fertilizer.)
- The larger your bin, the less likely you can easily kill your worms. It is particularly important when you're first starting out to not use a bin that is too small.

Bedding materials

Bedding can keep you from killing your worms, so use it!

- Shredded or hand-torn cardboard (cardboard is terrific because the open spaces between the outer surfaces of the cardboard will hold air that is critical to worms); be sure to remove labels & packing tape
 - Shredded newspaper (non-glossy)
 - Peat moss
 - Coconut coir
- } May compact or become matted, such that air flow is inhibited
- Aged/composted manure (NOT for smaller bins or new vermicomposters)
 - Finished compost
 - Paper egg cartons, paper towel rolls, toilet paper rolls, drink cartons, brown paper bags – all torn into small pieces
 - Shredded fall leaves (this author does not recommend)
 - Dryer lint (but not if you use “dryer sheets”)
 - Pet & human hair (but not if a lot of hair products are used)
 - Wood chips, shavings, sawdust (as long as it’s not from a toxic wood type)
 - Natural fabrics, such as cotton, wool, etc.

Bedding materials (cont.)

- For beginner vermicomposters, use LOTS and LOTS of bedding (error on the side of too much)
- Much of the bedding material will eventually become food for the worms
- First place the dry bedding materials into a large container and add water to cover. Allow the bedding to absorb as much water as it can hold, which may take between 2 and 24 hours, depending on the type of material it is (peat moss & coconut coir can be especially difficult to hydrate). Before adding bedding to bin, squeeze water out as much as possible – the bedding should have the moisture level of a well-wrung washcloth.
- Adding bulk to the bedding, such as sticks, will enhance the ability of the bedding to hold oxygen, especially for the materials that easily compact or if the bedding is overly wet
- In arid climates, such as New Mexico, a spray bottle of water kept conveniently near your worm bin will allow you to spray the top surface of the worm bedding whenever you feel it necessary. (Depending on what your bin is made of and what kinds of food wastes are provided to your worms, your worm bedding may still get overly wet at the bottom where moisture accumulates. This saturated bedding & food waste will eventually cause odors, attract pests, and decrease the habitability of your worm bin.)

Suggested foods

- Vegetable waste (the best all-round red wiggler food, but limit amounts of cruciferous veggies)
- Fruit waste (limit citrus)
- Used coffee grounds & filters (but don't use a lot at one time due to possibility of lowering pH out of tolerance range)
- Used tea bags
- Pulverized egg shells
- Grass clippings
- Some types of aged or composted manures (e.g., horse, cow, etc.), but these are not for newbies to vermicomposting or for smaller bins
- Plain starchy foods, like breads, pasta, rice (but not too much at one time)
- Purina Worm Chow (really!) or a dry mixture of ground oats and corn meal – dampen after sprinkling on surface of bed
- LIMIT garlic, onions, spicy foods
- NO bones, meats, dairy, oils, salty foods, or human/dog/cat feces

Feed your worms a couple times a week or when convenient for you. If you have a LOT of worms in your bin, you may need to feed daily, but this is best left to experienced vermicomposters. Keep in mind that worms can live off remaining food and bedding for some time.

Suggested Foods (cont.)

- 1) Adding too much food waste at one time (or without adequate amounts of bedding) can cause your bin to overheat, which is an excellent way to kill your worms.
- 2) Let your food scraps sit for a week or two before adding to the bin to allow microbes to colonize and become active
- 3) Optimize foods whenever possible. Always chop food wastes, to provide surface area for bacterial growth. Grinding food wastes in a blender will speed composting time considerably. Freezing or cooking will break down the structure of the food cells, providing additional surface area for microbes.
- 4) Always feed in a different area of the bin each time – Dig a hole in the bedding, stick in some dry bedding at the bottom of the hole if the bin seems fairly wet, dump the food waste in, and then cover back up. (As mentioned before, it is a good idea to always keep a 4-6” layer of dry bedding on the top surface of the habitat.)
- 5) Mix bedding with food wastes each time you feed to mitigate the wastes from heating up, which can harm your worms or encourage them to leave the bin
- 6) A small amount of sand or dirt can be added occasionally to provide grit for the worms’ digestive systems
- 7) Worms consume about ½ their body weight in food each day

Will Your Bin be Inside or Outside?

- Inside is great if you have the available space (that won't annoy your spouse!), as the temperatures people are comfortable in will work well for your red worms. Most indoor vermicomposters keep their worm bin in their basement, garage, kitchen, or in a shed, but only if that shed does not heat up during the day from direct sun, which isn't uncommon in New Mexico). (Note that a well-managed worm habitat will have NO ODOR.)
- Red worms have a fairly wide range of temperatures that they can usually survive in, approximately 40°– 85°F, but they will process food waste and reproduce optimally within a range of 55° – 78°F. Note that red worms have been known to freeze
- Red worms can be kept outdoors, provided they are protected from temperature extremes – no direct hot sun, no freezing temperatures, and protected from predators. *Insulation/mulch* can help protect worms from temperature extremes, e.g., straw bales stacked around and on top of the bin. Summer temperatures require that your bin be *located in the shade*.
- Red worms can live and prosper in an out-of-doors compost pile (potentially even within a “hot compost pile”), provided the compost pile is large enough so that the worms can protect themselves from temperature extremes by moving to the interior, outer edge, or bottom of the pile. Depending on local temperatures and weather conditions, a 4'x4'x4' out-of-doors compost pile may work well for your composting worms. In arid locations where compost piles must be provided with more moisture than other parts of the country, it will be important that bulking materials are incorporated into the pile to provide air pockets for the worms as well as for the hot composting process.

An example of a somewhat newer type of bin that allows for the harvesting of vermicompost out the bottom of the bin while still being able to feed your worms from the top. There is a handy drawstring opening/tightening system at the bottom and a mesh covering at the top with a zipper closure to keep pests out when you are not feeding your worms.

This type of vermicomposting structure definitely has advantages, but some disadvantages as well. Besides its ideal harvesting capability, this bin is made out of a heavy-duty fabric that allows for air flow through the bin as well as drainage of superfluous moisture out the bottom. However, vermicomposting in an arid part of the country makes it a bit more difficult to keep the bedding adequately moist.



Setting Up a New Vermicomposting System

DEMONSTRATION using a *Worm Factory 360*

(should take about 15 or 20 minutes)

Teacher/demonstrator will bring:

- Worm Factory set-up
- Shredded cardboard (dry)
- Tub to wet down cardboard & several gallons of water
- Plenty of newspaper and/or brown paper to line bottom of trays
- Food waste
- Aged manure
- Gloves
- Hand rake & trowel
- A couple hundred worms
- Several extra little bags of worms for anyone who would like to try vermicomposting

Critters

- Fruit flies (A)
- Fungus gnats (A)
- Black soldier flies (H)
- Springtails (H)
- Centipedes (H)
- Millipedes (A)
- Rolly (sow) bugs (H)
- Spiders (P)
- Mites (P)
- Rove beetles (P)
- Pot worms/white worms (A)
- White mites (?)
- Ants (A)
- Predatory flatworms (P)
- Birds (P)
- Moles (P)
- Shrews (P)
- Frogs (P)
- Slugs, snails (A)

(H) Potentially helpful critters

(A) Critters that are only annoying

(P) Some kinds are potentially predatory critters

Harvesting vermicompost

When is the compost ready to harvest?

Answer: If you notice that your bin has become pretty full, you can no longer recognize your input food wastes, and much of the bedding is unrecognizable, then wait a couple more weeks without feeding your worms, then harvest your vermicompost.

Here are 3 harvesting methods:

- 1) **Migration for food.** Move all the finished compost, including worms, to one side of the bin. Add new bedding and food waste to the other, now-cleared side. Theoretically, all the worms will migrate to the new food, and you'll be left with only finished vermicompost on the other side. Unfortunately, **MANY** worms and **ALL** the worm cocoons will remain in the finished vermicompost that you wish to take away. You could wait for the cocoons to all hatch and eventually find their way over to the new food, but it will never be a complete migration.

Harvesting vermicompost (cont.)

- 2) **Bright light.** Set out a tarp or large piece of plastic in a brightly-lit area (but not direct sun). Build many small but tall mounds (8" cones) out of compost (with worms) on the tarp. The worms will dive further down into the small mound to get away from the light. After a few minutes, scrape the top inch or two of now wormless-vermicompost off the top of each mound. Wait for the newly exposed worms to dive down deeper into the pile, wait a few minutes, then again scrape the top inch or two of wormless-vermicompost off the mound. Repeat until you are left with only worms, then transfer worms to new moist bedding. Don't let your worms dry out!
- 3) **Buried sack.** Using a small sack made out of nylon net or other type of netted fabric, insert a handful or so of the worms' favorite food, such as watermelon rinds, cantaloupe rinds, avocado peelings, corn cobs, etc. Close up the sack and bury on one far side of the finished vermicompost bin. Wait a couple days. The majority of the worms (but not all!) will have moved over to the sack of food. Remove all of the vermicompost except for the amount that surrounds the feasting worms. Fill the rest of the bin with new bedding and food wastes.

Miscellaneous facts about Vermicomposting

How long does it take for worms to make vermicompost?

Play this video showing a time-lapse of 20 days of worms eating sawdust & grass.

Video: [▶ 2:20](#)

<https://www.youtube.com/watch?v=n9Mnf9ysNSs>

What is the shelf-life of vermicompost?

Ideally, you should use vermicompost within a few months so that the beneficial microbes are still active/alive. Do not allow vermicompost to dry completely. Sunlight, heat, and rainfall will degrade its quality.

What do the red wiggler egg cocoons look like?

Red wiggler egg cocoons look like a very small lemon. They are about the size of a sesame seed, only fatter. Cocoons start off a pale yellow in color and turn dark brownish/reddish when the worms are about to hatch.

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Miscellaneous facts about Vermicomposting (cont.)

How do you make vermicompost tea?

Everybody does it different, but one semi-common method is as follows:

Add a cup of finished vermicompost to a stocking or other type of porous bag. Tie shut.

Fill a 5-gallon bucket about 3/4ths full with unchlorinated water. Attach an appropriately-sized plastic tube to an aquarium bubbler, placing the end of the tube into the bucket of water – you may need to weigh down the end of the tube with a rock or other type of weight to keep it at the bottom of the bucket. Insert the bag of vermicompost, which you may also need to weigh down with a rock. Turn on the aquarium bubbler.

Water should be furiously bubbling if the aquarium bubbler is powerful enough. Add 2 to 4 tablespoons of molasses to the water. Add a cup of Azomite or other rock powder.

Allow system to run for 24 to 48 hours. When complete, use within a few hours. Use a concentration of 1 part vermicompost tea to 3 parts water.

This diluted vermicompost tea may be sprayed on plants or poured into the soil around the base of the plant.

Miscellaneous facts about Vermicomposting (cont.)

How long do Red Wiggler worms live?

1 to 2 years in the wild; up to 10 years in a protected and well-maintained vermicompost bin. (Not sure I believe the 10 year bit!)

How long does it take a Red Wiggler egg cocoon to hatch?

28 to 30 days, but much longer if the weather is very cold.

How many baby worms come out of an egg cocoon?

Average number of viable hatchlings per cocoon is 2.5 to 3.8.

References

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