Worm-Powered Composting at Home

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Neighborhood Soil Rebuilders Composter Training Program
Institute for Local Self-Reliance

Rooting DC
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Vermicomposting is a process that relies on earthworms and microorganisms to help stabilize active organic materials and convert them to a valuable soil amendment and source of plant nutrients.

*It is a mesophilic process that should not heat up*

Source: Rhonda Sherman, Biological & Agricultural Engineering, NC State University
Types of Composting

Two different processes that require different conditions:

**HOT COMPOSTING:**
- Utilizes thermophilic ("heat loving") organisms
- **Temperature:** 55°F to 150°F max
- **Feedstock C:N ratio:** 25-35:1
- **Optimum water content:** 50 – 65%

**VERMICOMPOSTING:**
- Utilizes worms & bacteria
- **Temperature:** 40°F to 80°F max
- **Feedstock C:N ratio:** 25-35:1
- **Optimum water content:** 70-90%
Vermicomposting

- 30 days
- Mesophilic
- Passive aeration; no turning

Source: Rhonda Sherman of NCSU

Hot Composting

- 3 – 9 months
- Thermophilic
- Requires aeration or turning
Vermicompost (VC) Benefits

- Stable organic material with low C:N ratios.
- Have a high and diverse microbial and enzymatic activity.
- Have good moisture-holding capacity, and contain nutrients such as N, K, P, Ca and Mg in forms readily taken up by plants.
- Contain both plant growth hormones and humic acids which can act as plant growth regulators.
Complete digestive tract of an earthworm

- Anus
- Intestine
- Crop
- Pharynx
- Esophagus
- Gizzard
- Typhlosole
- Mouth

*Image credit: Copyright © The McGraw-Hill Companies, Inc. Permission required for reproduction or display.*
Earthworm Facts

✓ Cold-blooded animal (not insect)
✓ No lungs; breathes through skin
✓ Dies if skin dries out
✓ Hermaphroditic
✓ Light causes paralysis in ~60 minutes
✓ Babies hatch from cocoons smaller than rice

Source: Rhonda Sherman of NCSU
✓ >9,000 species of earthworms
✓ ½ inch to 22 feet long
✓ Must use correct species for vermicomposting

Source: Rhonda Sherman of NCSU

Giant Gippsland earthworm can grow to 13 feet (4 meters)

http://www.giantearthworm.org.au/
Three Earthworm Ecological Groups

Anecic
Live in soil (vertical burrows)
Eat soil & litter

Endogeic
Live in soil (horizontal burrows)
Eat soil

Epigeic
Live in litter (no burrows)
Eat litter

Source: Rhonda Sherman of NCSU

Source: Great Lakes Worm Watch, http://www.nrri.umn.edu/worms/identification/ecology_groups.html
Eisenia fetida is #1

✓ 1 pound = ~1,000 E. fetida
✓ Add 1-2 lbs worms to 1 sq ft surface area of bin
✓ Eat 25-35% of body weight daily
✓ Do not get from yard (not the right kind) or bait shop (expensive!)
✓ Buy from a worm grower
  ✓ Prices vary widely ($20 - $50 lb)

Source: Rhonda Sherman of NCSU

www.thewormfarm.net
Eisenia Fetida Redworms by The Worm Farm
Catalog / Worms

Redworms are nature's master composters. Please note: Worms are only shipped on Mondays and Tuesdays to avoid sitting in the Post Office over the weekends and to ensure live delivery.

See our Live Delivery Guarantee

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<th>Product</th>
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Redworms are nature's master composters. One pound of redworms by The Worm Farm can consume organic waste at the incredible rate of 1/2 to 1 lb per day and also leave behind natures ultimate soil amendment and plant growth enhancer - castings. Redworm castings condition the soil and resist leaching.
Principles of Vermicomposting

To maintain thriving worm population, optimal environmental conditions must be maintained:

1. Organic materials are added to the systems in thin layers (1-2 inches)

2. Earthworms require aerobic conditions and remain in the top 3-6 inches of a system, moving up as new organic matter is added

3. Temperature should be maintained ideally at 55-80°F

4. Moisture content should be 75-90%

5. Never cover beds with impermeable materials, such as plastic, which prevent oxygenation
What can they eat?

- Kitchen scraps & plate scrapings
- Coffee grounds
- Animal manure
- Agricultural crop residues
- Yard trimmings
- Scrap paper
- Organic byproducts from industries

Source: Rhonda Sherman of NCSU

Kitchen Scraps for Worm Bin

✓ Vegetables
✓ Fruit
✓ Coffee grounds & filters
✓ Eggshells
✓ Tea bags & leaves
✓ Leftovers

Source: Rhonda Sherman of NCSU
The “No-No” List

- Meat, grease, bones
- Dairy products
- Cat or dog feces
- Hot peppers, onions, garlic
- Citrus fruits & rinds
- Very salty or sugary foods
- Fruit pits
- Fresh grass

Source: Rhonda Sherman of NCSU

Adding Food Waste to Small Bin

✓ Use 3-prong tool
✓ Pull back bedding
✓ Put in food
✓ Cover with bedding
✓ Do not bury food in castings
✓ Wait until food is gone before adding more

Source: Rhonda Sherman of NCSU
More about Worm Feed

✓ Particle size
✓ Homogeneity
✓ Pathogens
✓ De-worming medicine
✓ Persistent herbicides
✓ Heating up
✓ Pre-composting

Source: Rhonda Sherman of NCSU
Vermicomposting Basics

✓ Provide up to 6 inches bedding
✓ Add composting earthworms
  o 1-2 pounds per square foot
✓ Apply < 2-inch layer of feedstock (chop or grind food into tiny pieces)
✓ Wait until food is eaten before adding more
✓ Cover food scraps with shredded paper, cardboard, cloth
✓ Keep bedding moist by misting it

Source: Rhonda Sherman of NCSU
Healthy Worm Bin Traits

- Bin smells earthy like a forest
- Few earthworms are on sides, lid of bin
- Bedding is fluffy (has air spaces)
- Contents of bin are damp but not soggy
- Earthworms have moist, glistening skin
- Small quantities of insects are in bin
- Castings are accumulating on bottom

Source: Rhonda Sherman of NCSU
Unhealthy Worm Bin Traits

- Bin has rotten odor
- Puddles in bottom of bin
- Liquid dripping from bottom of bin
- Fruit flies swarming bin
- Large number of red mites
- Bedding is dry
- Food/bedding entwined in large clumps

Source: Rhonda Sherman of NCSU
Harvesting Vermicompost

Method #1

- Remove top 4 – 6 inches of worm bed
  - Most earthworms will be in this layer
  - Use a pitchfork not a shovel
- Set on top of new bed
- Use shovel to remove VC from bed
- Draw remaining worms out of VC by laying screen or mesh cloth on top with food on it

Source: Rhonda Sherman of NCSU
Harvesting Vermicompost
Method #2: Sideways Separation

- Start new bed next to working worm bed
- Apply food to entice worms to move to new bed
- Only feed new bed
- After a few weeks, most worms should be in new bed

Source: Rhonda Sherman of NCSU
Harvesting Vermicompost

Method #3: Vertical Separation

- Set tray on top of working worm bed
- Tray has screen on bottom or holes that worms can move through
- Only feed top tray and ignore bottom bed or tray
- Eventually, most worms will move up into new tray

Source: Rhonda Sherman of NCSU
Harvesting Vermicompost
Method #4: Continuous-flow System
Harvesting Vermicompost
Method #5: Trommel Screener

✓ Remove top 4-6 inches of worm pile with pitchfork
✓ Pitch it into rotary trommel screener
✓ VC comes out through 1/2-inch or ¼-in. screen, worms exit on end
✓ Use shovel for rest of pile

Source: Rhonda Sherman of NCSU
Harvesting Vermicompost
Method #6: The Fast Way

✓ Find a sunny or bright spot
✓ Make little pyramids
✓ Harvest top of piles
✓ As piles get smaller, combine
✓ Last pile has all the worms
Beneficial Effects of VC on Soils

✓ Adds beneficial microbes and enzymes
✓ Improves soil structure
✓ Reduces erosion
✓ Increases soil porosity
✓ Holds moisture

Source: Rhonda Sherman of NCSU
VC Effects on Plants

- Extensive literature on substantial increases in rates of germination, growth, flowering and fruiting in crops grown with vermicomposts
- Increases usually independent of nutrient availability
- Vermicompost also decreases attacks by plant pathogens, parasitic nematodes, arthropod pests

Source: Rhonda Sherman of NCSU

Norman Q. Arancon, PhD, University of Hawaii at Hilo, “Vermicompost Effects on Plant Growth & Suppression of Diseases & Pests” presentation at International Vermiculture Conference, August 2015, Raleigh, NC (photos used by permission)
Turnips Grown With 0%, 10%, 20% Vermicompost

Slide courtesy of Rhonda Sherman of NCSU

Storing Vermicompost

- Dark, warm place
- Inside bag or bin with lid
- Aerated yet retains moisture
  - Tiny pinprick holes

Source: Rhonda Sherman of NCSU
Where to Use Vermicompost

Mix into soil:
- in gardens
- on lawns
- around trees
- in nurseries
- on farm fields
- for houseplants

Some producers sell vermicompost for $450 per cubic yard
Compost sells for ~$30 per cubic yard

Source: Rhonda Sherman of NCSU
VC Application Rates

- Established plants: Add 2T per quart potting mix around base of plant, water in. Repeat every 2-4 weeks
- Seedlings: Combine 1 part VC with 4 parts potting media
- Transplants
  - Small containers: add ½ cup to hole prior to planting
  - Larger plants, shrubs, trees: 1-2 cups prior to planting
- Lawn and turf
  - Established: 3.15 kg per 929 sq meters
  - New: 4.5 kg per 929 sq meters

Source: Rhonda Sherman of NCSU
Leachate vs VC Tea

✓ It is NOT the dark liquid that leaks out of a worm bin or compost pile
✓ That is LEACHATE
✓ It has passed through undigested, anaerobic areas of worm bin
✓ May contain organisms that can harm people, animals, or plants (pathogens, anaerobic microbes, sulfides, acids, high salts)
✓ Do not use on food crops; not recommended for houseplants or sensitive plants

Source: Rhonda Sherman of NCSU
Vermicomposting References

North Carolina State University Extension Vermicomposting Resources
https://composting.ces.ncsu.edu/vermicomposting-north-carolina/

Vermiculture Technology: Earthworms, Organic Waste, and Environmental Management by Edwards, Aroncon, Sherman

The Science of Vermiculture: The Use of Earthworms in Organic Waste Management

The Potential Reuse of Biodegradable Municipal Solid Wastes (MSW) As Feed Stocks in Vermicomposting

Worm Reproduction & Development
http://www.eulesstx.gov/composting/vc_reproduction.htm
http://www.eulesstx.gov/composting/vc_anatomy.htm

Neighborhod Soil Rebuilders
COMPOSTER TRAINING PROGRAM
NCSU’s 19th Vermiculture Conference
November 10-11, 2018

Topics:
✓ Flow-Through Vermicomposting
✓ Vermicompost Effects on Plant Growth, Pest and Disease Suppression
✓ Vermicomposting Operation Options
✓ Effective Marketing of Vermicompost Products
✓ Vermi-Biz Strategies and Common Pitfalls

https://composting.ces.ncsu.edu/vermiculture-conference/
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