

What is composting? Using the natural process of decay to change organic wastes into a valuable humus-like material called compost **Grass clippings** Compost Food scraps aves

Benefits of compost Promotes soil health

- Supplies organic matter to soil
- Attracts earthworms
- Stimulates beneficial soil microorganisms
- Increases soil water holding capacity
- Increases soil nutrient retention



Benefits of compost Promotes soil health

- Improves soil tilth and friability
- Improves soil drainage
- Loosens heavy clay soils
- Suppresses soil-borne plant pathogens (diseases)

Benefits of compost Plant nutrients

Compost is <u>not</u> a fertilizer, but does contain plant nutrients

- Nitrogen and phosphorus are mostly in organic forms
 - Released slowly to plants
 - Not readily leached from the topsoil
- Compost contains many trace nutrients that are essential for plant growth



Composting -

Speeding up the natural decay process

- A compost <u>pile</u> or <u>bin</u> allows you to control
- Air (oxygen)
- Water
- Food, and
- Temperature



By managing these factors you can speed up the otherwise slow natural decay process

What do you need to make compost?



- <u>Decomposers</u> Your composting work crew. These are the microbes (mainly bacteria and fungi) that do all the work for you.
- Food for the decomposers
 The organic materials to be composted
- The right amount of air, water, and warmth to keep the work crew happy

Where do the decomposers come from?

If you build it, they will come...

- Soil
- Leaves
- Food scraps
- Manure, and
- Finished compost Each of these will add microorganisms to the compost pile



One teaspoon of good garden soil to which compost has been added contains

- 100 million bacteria
- 800 feet of fungal threads

Numerous additives and starters are available but are not needed for good or rapid composting



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INFERSION BIOLOGIA

What is the best food for your decomposers?

All organic materials will compost, but not all should be added to a backyard compost pile

Organic wastes that should be composted include:



Materials to avoid...

Avoid organic materials that could cause problems during or after composting

- Oil, fat, grease, meat, fish or dairy products, unwashed egg shells (tend to attract pests, vermin)
- Hard to kill weeds (bindweed, bermudagrass, nutsedge) and weeds that have gone to seed (could infest garden area when compost is used).

Materials to avoid...

Cat or dog waste (attracts pests, could spread disease)





Diseased or insect ridden plants (could infect or attack garden plants when compost is used)

Materials to avoid...

- Lime (increases compost pH and promotes ammonia odor problems)
- Wood ash, add sparingly to the pile (will add some potash to compost but will increase pH and ammonia odor problems)



Is shredding necessary?



Have greater surface area per unit volume

Allows microbes to get at more of the food

Chipping or shredding coarse materials (twigs, stems) will speed up the rate at which they decompose

Is shredding necessary?

but...

Smaller particles will also decrease airflow into the pile

- May lead to anaerobic conditions

- Pile may need to be turned more often

More about food for your decomposers

- Your compost workers will thrive if you give them a balanced diet.
- Compositing will be most rapid if the decomposers are fed a mix of carbon-rich and nitrogen-rich materials.
- Carbon-rich organic wastes are known as "browns"
- Nitrogen-rich organic wastes are known as "greens"

Browns

High carbon materials such as

Leaves (30-80:1)

Straw (40-100:1)

Paper (150-200:1)

Sawdust (100-500:1)

Animal bedding mixed with manure (30-80:1)



Greens High nitrogen materials such as

Vegetable scraps (12-20:1) Coffee grounds (20:1) Grass clippings (12-25:1) Manure

- -Cow (20:1)
- -Horse (25:1)
- Poultry (10:1), with litter (13-18:1)
- Hog (5-7:1)



Browns

- Decay very slowly
- Coarse browns can keep pile aerated
- Tend to accumulate in the fall
- Tie up nitrogen in soil if not fully composted
- May need to stockpile until can mix with greens

Greens

- Decay rapidly
- Poor aeration may have foul odors if composted alone
- Tend to accumulate in spring and summer
- Supply nitrogen for composting
- Best composting if mixed with browns

Aerobic composting

- Compositing with decomposers that need air (oxygen)
- The fastest way to make <u>high quality</u> compost
- Produces no foul odors
- Aerobic decomposers produce heat



Aerobic composting and temperature

- Active composting occurs in the temperature range of 55°F to 155°F
- Pile temperature may increase above 140°F but this is too hot for most bacteria and decomposition will slow until temperature decreases again.



 A thermometer is a nice tool but is not essential for good composting

Does my compost pile have to get hot?

- Good compost can be made in a pile that never gets hot, but...
 - Decay will be slower and it will take longer to make compost
 - Not enough air, to little or too much water, or too many browns in the mix could all keep a pile from heating.
- High pile temperature provides the benefits of
 - The most rapid composting
 - Killing pathogenic (disease-causing) organisms
 - Killing weed seeds

Compost Temperature

Tremendous microbial activity produces heat.



Getting air to your decomposers

Warm air rising through the pile draws fresh air in from bottom and sides Wind can stimulate aeration



Pile aeration Depends upon adequate porosity

- Porosity is the air-filled space between particles
- "Browns" help to maintain good porosity in the pile
- A compacted pile has lost porosity; can be increased by turning
- Aeration can be increased by inserting sticks, cornstalks, or perforated pipes into or under the pile



Pile aeration Getting air to your work force



 Turning the pile mixes fresh air into the pile



• Turning tools can make the job easier

Water

Rapid decomposition requires optimum water content

- If too dry, bacterial activity will slow or cease
- If too wet, loss of air in the pile will lead to anaerobic conditions
- Pile water content should be at 40-60%
- As wet as a wrung-out sponge
- If too dry, add water as you turn the pile
- If too wet, add browns and/or turn the pile



Taking care of your compost pile

- The most rapid composting is achieved by
 - Adding mixed browns + greens
 - Regularly turning (mixing) the compost pile
 - Controlling water content
- When pile no longer heats after mixing, allow it to cure (stand without mixing) for at least 4 weeks before using the compost



Compost Temperature – Turned System



Making compost the fast way (Instructions for active composters)

- Turn the pile every 5 to 7 days,
 - -move outer material to the pile center
 - –add water if needed
- During the first few weeks, temp should reach 140°F

 After about 4 weeks, less heat will be produced and compost will maintain lower temp (100°F) Making compost the fast way (Instructions for active composters)

- •After about 4 more weeks, the pile will no longer heat after turning and volume will be about one third of original.
- Allow the pile to cure (stand without turning) for 4 more weeks before using the compost

When is compost finished?

Compost is mature when

- The color is dark brown
- It is crumbly, loose, and humus-like
- It has an earthy smell
- It contains no readily recognizable feedstock
- The pile has shrunk to about 1/3 of its original volume



Sift out oversized pieces for more composting



Simple tests for finished compost

Bag test: sealing compost in a plastic bag for several days should produce no foul odor





<u>Germination test</u>: will seeds germinate in the compost? (good test to use if compost will be part of a potting mix)

Where should I put my compost pile?

- Shaded area will help prevent drying out in summer
- Avoid areas that will interfere with lawn and garden activities
- Adequate work area around the pile
- Area for storage
- Water available


Considerations for locating the compost pile

- Good drainage
- Away from any wells
- Near where finished compost will be used
- Be a good neighbor
 - Make your composting area attractive, or
 - Keep it out of your neighbors' view

Composting options

- Pile
- One-bin
- Multi-bin
- Wire collector
- Tumbler
- Trench



Bio-Activator Stacking System







Compost Mixer™





Flowtron® Expandable System





Earth Machine

Classic

Brave New™

Composter





Green Keeper

Compost Corral[®] Corners



Enviro-Cycle Base

Tumbler





Pile composting

Passive

- Most inexpensive
- Minimal management
- Inconsistent results





Pile composting

- Aerated
 - Scaleable
 - Turned every 1-14 days
 - Can be expensive





Bin construction

- Ideal size is approximately a 3-foot cube
 - Promotes good air movement
 - Retains sufficient heat to maintain warm temps
 - Piles larger than 5 x 5 x 5 feet are difficult to turn and tend to become anaerobic in the center







One-bin composter

- Most popular
- Inexpensive
- Easily movable
- Has a lid
- Some have bottoms
- Is scavenger-resistant
- Holds heat well
- Easy to access finished product
- Often made of recycled plastic







The Earth Machine Bin



Multi-bin composter

- For households with significant waste
- Move materials between bins as batches finish
- For the "serious" composter





Wire collector composter

- Quick to build
- Inexpensive
- Little heating takes place
- Susceptible to scavengers
- Can be covered with lid
- Easy to access remove the wire!







Tumbler composter

- Small
- Can be expensive
- Very fast 3 weeks!
- Many choices









Homemade tumbler composter



Homemade tumbler composter



Trench composting

- Dig trench or hole ~ 1 ft deep
- Add wastes + garden soil
- Cover with soil
- Easy
- Protects from pests
- Improves garden soil





Compost troubleshooting Odors

Odors are one of the most frequent but easily avoidable composting problems.

<u>Rotten odor</u>

- Putrid smell or rotten egg smell
- Usually results from anaerobic conditions
- Excess moisture, compaction
- Turn pile, add dry porous material (browns), cover kitchen scraps
- <u>Ammonia odor</u>
 - Too much nitrogen (greens)
 - Add high carbon material (browns), turn pile

Compost troubleshooting Temperature

Low pile temperature

- Pile too small, cold weather, too dry, poor aeration, or lacks nitrogen
- Make pile bigger or insulate sides, add water, turn the pile, add greens or manure

High pile temperature

- Pile too large, insufficient ventilation
- Reduce pile size, turn

Compost troubleshooting

Pests: raccoons, rats, insects

- Presence of meat scraps or fatty food waste rotten odors
- Remove meats and fatty foods, cover with sawdust or leaves, turn the pile
- Compost in an animal-proof bin
 - Covered bin, trash can bin, cone bin, or barrel bin
 - Wire mesh sides and floor (1/4 1/2 in openings)
- Use worm composting (vermicomposting) for food scraps







Using finished compost

Soil amendment

- Be sure that compost is mature, has an earthy smell (no ammonia or rotten smell), looks dark and crumbly with no recognizable feedstock
- Compost improves soil health when mixed in the top 4 to 6 inches (work in no more than a 2" layer of compost)
 - Will improve water and nutrient retention of sandy soils
 - Will loosen compacted clay soils and make them more friable

Using finished compost

Lawn topdressing

- Be sure compost is very mature to avoid harming the lawn
- Use fine (screened) compost, ¹/₄" depth raked over lawn
- Best if lawn is cored before applying compost
- Retains moisture, supplies slow release nutrients, prevents soil compaction
- Potting mix
 - Compost must be very mature to avoid injury to plants
 - Use fine-textured compost
 - Mix no more than 1/3 compost by volume

Mulching benefits

- Prevents mower blight
- Suppresses weeds
- Reduces turf competition
- Improves moisture retention
- Moderates soil temperature
- Reduces soil erosion
- Adds organic matter
- Can provide nutrients
- Easier to maintain beds
- Pleasing to the eye





Lawn mower blight



Weed-wacker wounding

Permanent weed suppression



How mulch works







Too much mulch can starve plants for water





Cooling effects of mulches

•Compared:

- Bare ground
- Rubber mulch
- Mini-bark
- Pallet mulch
- Cedar mulch

Results:

- Ambient air temp 98.2°F
- Soil temps at 1¹/₂ inches
 - Bare soil 101.6°F
 - Under mulches 83-89°F

Source: Dr. Curtis Swift, Colorado State University Extension, 8-13-2003

Inorganic mulches

- Rock, gravel, rubber, plastic, weed barrier fabric
 - Do not provide the soil benefits of organic mulch
 - Rock can increase soil temperature as it absorbs heat
 - Light-colored rock may reflect heat onto plants



Rubber mulches

- Weed control not as effective as organic mulches
- Flammable highly & difficult to extinguish
- Permanent? like organic mulches, it decomposes
- Non-toxic? Leachates can be toxic to aquatics and plant roots



Source: Dr. Linda Chalker-Scott, Ph.D, Extension Horticulturist, Washington State University

Inorganic mulches

| Material | Resistance to compaction | Attractiveness | Resistance to wind blowing | Availability | Source of weeds and disease | Fire hazard | Comments |
|----------------------------|--------------------------------|----------------|-------------------------------|--------------|-----------------------------------|----------------|--|
| Black plastic film | Tears | Unsatisfactory | Unsatisfactory | Excellent | Excellent | No | Must anchor. Unsightly. |
| Crushed rock | Excellent | Good | Excellent | Excellent | Excellent | No | Many colors available. Avoid crushed limestone. |
| Geotextile weed barrier | Excellent | Unsatisfactory | Unsatisfactory | Excellent | Excellent | No | Must anchor. Best covered by other mulch. |
| Gravel | Excellent | Good | Excellent | Excellent | Excellent | No | Use sparingly. |
| Volcanic rock | Excellent | Good | Excellent | Good | Excellent | No | Small sizes moved by water. |
| Perlite | Good | Good | Poor | Excellent | Excellent | No | Good as soil amendment. |
| Vermiculite | Fair | Fair | Poor | Excellent | Excellent | No | Physical structure breakdown. |

Resource: https://extension2.missouri.edu/g6960

Organic mulches

- Leaves/leaf mold
- Grass clippings
- Wheat straw
- Pine straw
- Shredded bark or wood waste









Single-season mulches

Grass clippings

- Leaves
- Compost
- Shredded paper
- Peat moss
- Straw
- Corn stalks
- Ornamental grasses (chopped)



Organic mulches

(that break down in one season)

| Material | Resistance to compaction | Attractiveness | Resistance to wind blowing | Availability | Source of weeds & disease | Fire hazard | Comments |
|-------------------|--------------------------------|----------------|----------------------------------|--------------|---------------------------------|----------------|--|
| Compost | Good | Good | Excellent | Excellent | Fair | No | Value varies with ingredients |
| Нау | Good | Fair | Good | Fair | Fair | Yes | Good when available |
| Lawn clippings | Poor | Poor | Good | Excellent | Fair | No | Compost first |
| Leaf mold | Good | Good | Excellent | Excellent | Fair | No | Value varies with ingredients |
| Leaves | Unsatis- factory | Good | Poor | Excellent | Good | Yes | Compost first |
| Peat moss | Good | Excellent | Excellent | Excellent | Good | No | Universally available, Coarse grades best |
| Straw | Excellent | Poor | Poor | Good | Poor | Yes | Often contains grain seed |
| Waste paper | Fair | Unsatisfactory | Unsatis- factory | Excellent | Excellent | No | Must be shredded. Unsightly |

Resource: https://extension2.missouri.edu/g6960

Persistent mulches

- Bark chips
- Wood chips
- Sawdust
- Pine straw
- Cottonseed hulls
- Pecan hulls







Organic Mulches

(that persist more than a year)

| Material | Resistance to compaction | Attractiveness | Resistance to wind blowing | Availability | Source of weeds & disease | Fire hazard | Comments |
|---------------------|--------------------------------|----------------|----------------------------------|--------------|---------------------------------|----------------|---|
| Bark chunks | Excellent | Excellent | Excellent | Excellent | Excellent | No | Generally available. Expensive |
| Cottonseed hulls | Good | Fair | Poor | Poor | Good | No | Hard to keep in place |
| Pine needles | Excellent | Good | Good | Fair | Good | Yes | Especially good on acid-loving plants |
| Sawdust (coarse) | Fair | Fair | Good | Good | Excellent | No | Add nitrogen. Use aged material |
| Sawdust (fine) | Poor | Fair | Poor | Good | Excellent | No | Compacts too easily. Requires nitrogen |
| Shredded bark | Good | Excellent | Excellent | Good | Excellent | No | Good when available |
| Wood chips | Good | Good | Excellent | Good | Excellent | No | Inexpensive when available |
| Wood shavings | Good | Good | Good | Fair | Excellent | Yes | Add nitrogen when spaded under |

Resource: https://extension2.missouri.edu/g6960

Problems with Organic Mulches

- Toxic metabolites
 - -Sour mulch syndrome
- Exotic fungal wildlife
 - -Artillery fungus -
 - –Bird's nest fungus
 - −Stinkhorn fungus→







Sour Mulch Syndrome

Soggy Mulch Pile

Volatile Organic Acids Leaf Burn



Effect of volatile acetic acid from sour mulch

Artillery (Shotgun) Fungus

Woody mulch + Sphaerobolus stellatus

Black spots on cars and house siding


Exotic Fungal Wildlife



Bird's nest fungus (*Cyathus striatus*)



Stinkhorn fungus (*Mutinus elegans*)

Resource: http://www.ncbuy.com/flowers/articles/01_10400.html

Proper mulching techniques

- 2"- 3" thick layer; refresh yearly or as needed
- Start 3"- 4" from tree trunk
- Extend out to dripline
- Think "bagel", not "volcano", around trees









Proper mulching techniques

- Avoid base-of-tree planters
- Keep wood mulches away from house foundation







How much mulch to order?

•Example #1:

For a bed that is 30 feet long and 6 feet wide, how much mulch is needed to apply a 3-inch layer?

- First, convert the thickness of the layer in inches into feet (3" = 0.25 ft.). Multiply the thickness in feet by the square footage of the bed.
- (30' x 6') x 0.25'= 45 cu.ft.
- **Answer:** 45 cu.ft. ÷ 27 = **1.7 cu.yds.**

How much mulch to order?

• Example #2:

- How much mulch is needed to apply a 3-inch layer to 10 trees with a crown spread of 6 feet diameter?
- First, convert the thickness of the layer in inches into feet (3" = 0.25 ft.). Then multiply diameter x diameter x 0.8 to get square footage area per tree. Then multiply area x thickness x number of trees.
- (6' x 6' x 0.8) x 0.25' x 10 trees = 72 cu.ft.
- •Answer: 72 cu.ft. ÷ 27 = 2.7 cu.yds.

Composting / mulching resources

G6956 Making and Using Compost

G6957 How to Build a Compost Bin

- nttps://extensionz.missouri.edu/g69
- G6960 Mulches
- G6958 Grass Clippings, Compost and Mulch: FAQs
- Compost Analysis (MU Extension)
- Worm Composting (MO Dept. of Natural Resources)
- MP906 Community Gardening Toolkit (MU Extension)
- Webster County Extension Center

nttp://extension.missouri.edu/webster

For More Information

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