



Composting in The Bahamas Workshop

**New Providence Community Centre
June 14, 2014**

**Organized by:
New Providence Community Centre Recycling Depot**

**A joint project by:
Cans for Kids Bahamas
WasteNot Ltd.
New Providence Community Centre
Field to Fork Community Farm
ACE Diabetes**

I. What is Composting and Compost?

Composting is the controlled decomposition of organic materials by microorganisms.

Compost is partially decomposed organic matter.

Humus is completely decomposed organic matter.

Mulch is organic or inorganic materials spread in a layer on the soil surface.

Benefits and Uses of Compost

Compost offers many benefits to the landscape and garden.

For example, compost:

- Improves soil tilth condition, and structure;
- Increases the soil's ability to hold water and nutrients;
- Supports living soil organisms;
- Helps dissolve mineral forms of nutrients;
- Buffers soil from chemical imbalances;
- May provide biological control of certain soil pests; and
- Helps return organic materials to the soil, and keeps them out of landfills and waterways.

Compost can be used as a mulch, a liquid "fertilizer", or incorporated into the soil or potting mixes.

II. What Can Be Composted?

The basic rule for backyard composting is that you can compost:

Anything that was once a plant!

Greens and Browns

Backyard Composting is primarily a biological process so you must feed your microorganisms to keep them happy. Microbes need both carbon (C) and nitrogen (N), food sources to function. All materials contain both C and N. The ratio of carbon to nitrogen within a material is called the carbon to nitrogen ratio (C:N).

Materials with favorable proportions of carbon and nitrogen (C:N) offer the decomposer microorganisms a "complete meal".

"Greens" - Nitrogen Sources

Materials that are a good source of nitrogen are called "Greens" and are characterized as having a low C:N ratio (C:N ratio less than 30:1) and are generally high in moisture and fast to decompose. Examples of "greens" include manure, inorganic fertilizer, vegetable kitchen scraps, green leaves, and grass clippings. Not all "greens" are green in color. For example, coffee grounds are a nitrogen source.

"Browns" - Carbon Source

Materials that are high in carbon relative to nitrogen (i.e., C:N greater than 30:1), are called "Browns", and are generally dry and slow to decompose. They are generally brownish or darker in color. Examples of "browns" include: straw, leaves, chipped branches and tree trimmings, paper, and sawdust. Browns decompose at low temperatures unless combined with a source of nitrogen. Finding a mix of greens and browns that is in balance can be important. The optimum C:N ratio for rapid composting is about 30:1.

"Greens and Browns"

| "Green" High Nitrogen | "Brown" High Carbon |
|---|--|
| <ul style="list-style-type: none">• Fast to decompose• Nitrogen provides the microbes with the raw element of proteins to build their bodies and reproduce.• examples: manure, kitchen waste, grass clippings, inorganic nitrogen rich fertilizers. | <ul style="list-style-type: none">• Slow to decompose• Carbon is the energy source for the microbes that help break down the materials.• examples: leaves, wood chips, straw, sawdust. |

If there is a specific material that you are wondering about, go to "Can I compost it?"

<http://sarasota.ifas.ufl.edu/compost-info/tutorial/can-i-compost-it.shtml>

Some people are concerned about problematic materials such as possible residues from pesticides, herbicides, weeds, and/or plant diseases. The most conservative response to these concerns is to avoid adding these materials to the composting system. However, many people who compost at home use their own judgement about what materials can be added to the compost system.

III. Elements of Composting

Rapid composting requires an environment in which microorganisms will thrive. To compost well, you must "think like a microbe" and create the best environment to support microbial activity. Microbes have similar environmental needs as people: water, air, comfortable temperatures, and food. The elements of the compost environment that are important for rapid, efficient composting, include:

- Moisture
- Aeration
- Pile temperature
- Particle size
- Carbon to nitrogen ratio

Moisture

Microbes need moisture to thrive. At the ideal moisture level, 40-60%, a handful of compost will feel wet but water cannot be squeezed out of it. Some people compare this to the feeling of a damp sponge.

It may be necessary to add water to the composting system to keep it moist. Add water when building and turning the compost pile.

Compost should be kept moist, but not soggy. If the materials are too wet, they will compact and restrict the airflow through the pile. This leads to anaerobic (no oxygen) conditions, which slow down the degradation process and causes foul odors. A pile which becomes too wet should be turned. Turning the compost will dry it out and add oxygen.

Aeration

Aeration means adding oxygen to your compost system. Microbes need oxygen to break down organic materials efficiently. Because they reproduce so quickly under ideal conditions, microbes may deplete the available oxygen through their activity. Therefore, it is important to aerate your compost.

You can aerate your compost by turning it. This directly incorporates oxygen into the pile. You can aerate by adding bulky items. Bulky items provide air channels so that oxygen can flow into and through the compost. Bulky items also keep the pile from settling and compacting, which could restrict oxygen flow. Bulky items include oak leaves, pine needles, chipped twigs, and straw.

You can aerate by probing the pile with a piece of rebar or an aeration tool. Simply probe the devise in several places in the pile. This will create passageways for air to enter the pile.

Pile Temperature

Compost pile temperature is a function of the biological activity within the composting system, and, to some extent, its exposure to the sun. When microbes flourish, they will raise the pile temperature through their metabolism, reproduction, and conversion of composting materials to energy.

The main reason to be concerned about pile temperature is that maintaining a minimum pile temperature of 131°F for 3 days is desirable to destroy weed seeds or plant pathogens. To establish this highly efficient biological system requires the proper food balance (a mixture of nitrogen and carbon rich materials), sufficient pile size (approximately one cubic yard), oxygen and adequate moisture content (moist but not soggy).

Your composting system may not reach higher temperatures during the composting process (see Troubleshooting - Pile too Cool). If your pile does not heat up, don't worry: Compost Happens! at all temperature levels.

Particle Size

Smaller materials have more surface area available for microbes to attack. Therefore, reducing the particle size of raw materials will increase the speed of the composting process. Size reduction also reduces the volume of the compost pile, thereby saving space.

It is a good idea to chip or mulch small limbs and twigs to a size of 2-3 inches before composting.

Particle size can be too small. For example, sawdust sized and wet materials can decrease aeration, reduce the rate of composting and perhaps cause anaerobic conditions leading to odor problems.

Carbon to Nitrogen Ratio

Scientists speak of an ideal ratio of Carbon to Nitrogen of 30 to 1 (30:1), as measured on a dry weight basis. This is known as the C:N ratio. But ...

DON'T GET CAUGHT UP IN THE NUMBERS.

What's important is to understand how greens and browns affect the compost process and to use them to manage your compost system.

You can calculate the C:N ratio of your materials by using the chart below. For example, if you have two bags of grass clippings (C:N = 20:1) and one bag of leaves (C:N = 60:1) then combined you have a C:N ratio of $(20:1 + 20:1 + 60:1)/3 = (100:1)/3 = 33:1$, which is pretty close to the ideal (C:N = 30:1).

| Material | C:N Ratio |
|----------------------------------|-----------|
| Coffee Grounds | 20:1 |
| Fruit Wastes | 35:1 |
| Grass Clippings | 20:1 |
| Horse Manure w/ Litter | 60:1 |
| Leaves | 60:1 |
| Newspaper | 50-200:1 |
| Oak Leaves (Green) | 26:1 |
| Peat Moss | 58:1 |
| Pine Needles | 60-110:1 |
| Rotted Manure | 20:1 |
| Sawdust / Wood | 600:1 |
| Sawdust Weathered for two months | 325:1 |
| Straw | 80-100:1 |
| Table Scraps | 15:1 |
| Vegetable Trimmings | 12-20:1 |

Note that all plants have more carbon than nitrogen; that is why the C:N ratio is always above 1.0. Grass has a great deal more nitrogen than wood chips, thus it is called a "green" material. Wood chips are very high in carbon, but low in nitrogen. Thus they are called a "brown" material.

All plant material contains a mixture of Carbon and Nitrogen, and all plant material will compost over time. You will find the right mix of materials for your composting needs by trial and error. Don't worry so much about the C:N ratio, just understand that it can be a factor in your composting process.

IV. Meet Your Microbes

This Tutorial advocates "aerobic" composting, which means composting with oxygen loving microbes. Composting without oxygen is called "anaerobic". Both systems will break down organic matter, but aerobic composting is generally faster, hotter, and easier to manage. Most importantly, anaerobic (no oxygen) decomposition creates objectionable odors. So stick with oxygen loving aerobic microbes.

Generally speaking, three classes of bacteria will go to work for you in your aerobic pile:

- **Psychrophiles** - the low temperature bacteria
- **Mesophiles** - the medium temperature bacteria
- **Thermophiles** - the high temperature bacteria.

In tropical and subtropical climates, which are warm so much of the year, composting rarely utilizes the low temperature bacteria. "Most garden compost begins at mesophilic temperatures, then increases into the thermophilic range These high temperatures are beneficial to the gardener, because they kill weed seed and diseases that could be detrimental to the planted garden" (The Rodale Book of Composting, Rodale Press, Emmaus, PA (1992), pp. 34-5). Compost thermometers are available for measuring compost temperature.

In later stages, other organisms, will assist with pile decomposition, including:

- Actinomycetes - a medium temperature colonizer.
- Fungi
- Sowbugs
- Millipedes
- Centipedes
- Spiders
- Earthworms

V. Composting Methods

- Cold or "Slow" Composting
- Sheet Composting
- Trench Composting
- Cold Bin Composting
- Heap Composting
- Hot or "Fast" Composting
- Using Earthworms

Cold / Slow Composting

Cold / Slow Composting is for people who have more carbon (brown) material than nitrogen (green) material, and are not concerned about a slow composting rate, a desire for weed seed destruction, or a need for plant disease suppression.

The advantages of cold/slow composting include ease of implementation, lower level of management required.

The disadvantages of cold/slow composting include slow rate of decomposition and potential for pests to excavate buried wastes. Additionally, if the raw materials contain weed seed or plant pathogens, these will not be destroyed in the composting process.

Some examples of cold/slow composting include:

- Sheet composting
- Trench composting
- Cold bin composting
- Heap composting

You may also use this method to build up organic matter throughout the yard. You can build cold piles wherever you need compost, under trees, in washed out areas, in the space that will be next year's garden, etc. Over the course of a year or two, the material will decompose, adding valuable organic matter to the soil, without the need for a formalized bin or composting activity.

Sheet Composting

Sheet Composting involves top-dressing organic material on the soil surface and allowing the materials to decompose without further manipulation. As the materials decompose, compost filters slowly into the soil below. Leaves, wood chips, and other mulches are examples of sheet composting.

The advantages of sheet composting include ease of implementation and the moisture retention qualities of mulch.

The disadvantages of sheet composting include slow rate of decomposition and it is not compatible with composting all materials such as kitchen scraps. Additionally, if the raw materials contain weed seed or plant pathogens, these undesirables will not be destroyed in the sheet composting process.

Trench Composting

Trench Composting is a relatively straight-forward method of composting directly in the soil. This method does not require a bin. Simply dig a trench 8 inches deep in the garden area, fill with 4" of kitchen scraps and backfill with soil.

After a few months, the material will have decomposed sufficiently for planting above the compost trench. For large amounts of material, consider roto-tilling the material into the soil, and waiting a season before planting.

The advantages of trench composting include ease of implementation and its ability to handle kitchen scraps without attracting pests as readily as in sheet composting.

The disadvantages of trench composting include slow rate of decomposition and potential for pests to excavate trenches. Additionally, if the raw materials contain weed seed or plant pathogens, these undesirables will not be destroyed in the trench composting process.

A variant of trench composting was taught to the pilgrims by the Native Americans. You may have heard the story of how Squanto showed the pilgrims how to fertilize their corn crops by burying fish scraps underneath the corn. As the fish composted, nutrients were released for the crop.

Cold Bin Composting

Simply fill your compost bin halfway with browns and bury kitchen scraps in the bin. After a month or so, start layering kitchen scraps and thoroughly covering with browns and a little soil. Keep adding material throughout the year. As the bin fills up, start a second compost bin. After a year or so, the material in the first bin will have decomposed enough for most landscape uses. Start harvesting from the bottom of the pile.

With Cold Bin composting, bury or cover new material with browns. Exposed food, like these oranges, will attract pests.

Heap Composting

You do not have to have a bin to have a compost system. A compost heap can be created anywhere in your yard, it's simply a collection of compostable materials placed in a designated area. However, bins help keep the compost neat and tidy, and may help you exclude pests if they are a problem.

Hot / Fast Composting

Hot / Fast Composting will yield the fastest rate of composting and best control of weed seed and plant pathogens. Hot composting is also the most intensive method and requires several elements to succeed, including:

- a minimum of 1 cubic yard of material to start the pile.
- a blend of greens and browns (C:N Ratio)
- proper moisture content
- frequent turning to provide aeration.
- particle size of less than 2" - 3"

Using Earthworms

Many people know the value of worms in their garden. Worms are great decomposers, especially red-wigglers and African night crawlers. If you generate only kitchen and table scraps, or if you live in an apartment, composting with worms (officially called "vermicomposting") is the way to go.

VI. Build a Pile

Microbes are not much different than people in terms of their basic needs, so be sure to provide your microbes with all of the basics:

Food: Carbon and Nitrogen (Browns & Greens)

Water: Moist, not soggy

Air: Oxygen

Volume: 3' long x 3' high x 3' deep 3-5 foot diameter by 3 feet high cylinder

Particle Size: Less than 2-3 inches

Sandwich Method

Layer compost materials/ingredients into the composting system using a balance of Green and Brown materials. Over time, you will develop a unique "recipe" for your composting system.

The general rules and reasons are:

| Rule | Reason |
|---|--|
| 3 - 4" layers alternating Green (high Nitrogen) and Brown (high Carbon) materials. | Thin layers help prevent anaerobic (smelly) pockets from developing and allows microbes access to both Green and Brown food sources. |
| Water each layer as you build it so material is moist not wet, like a wrung sponge. | Even distribution of moisture. |
| End with a Brown layer on top. | To filters odors, if any, before they leave the compost system. |

Mix-It! Method

If you are using a "no-turn" method, or if you want to speed up the composting process, try the Mix It! Method. Simply mix up the green and brown materials before adding them to the compost system. This prevents the moist greens (grass clippings, for example) from forming compact layers that may restrict the flow of water and oxygen through the pile.

Add the mixture to the compost system in 4" batches. Water each batch so that the moisture is evenly distributed. It's really difficult to get water into the whole pile after the pile has been built, so add water as you build the pile.

Mix materials in a wheelbarrow and then put them in the compost bin.

Adding More

You can add fresh materials to an actively (or passively) composting pile. One way to add materials to an existing pile is to add them as you mix or turn the pile. Burying new materials in the pile also works well. Eventually, you will want to start a second batch of compost for adding fresh materials. This will give the first batch of compost time to stabilize and mature.

The materials you add will supplement the existing food base. If you add more greens, the effect will be adding nitrogen and potentially speeding up the composting process, increasing moisture, and/or heating up the pile. If you add more browns, the effect will be increasing carbon, and potentially slowing the composting process, drying out the pile, and/or reducing pile temperature.

VII. Managing a Compost System

After you have built your compost pile, managing it involves four basic activities:

- Monitoring
- Mixing and Turning
- Finishing/Curing
- Screening

Monitoring

Monitor Smell

- Turn if there are any odors
- Add "browns" if odors persist
- Use a brown layer on top of compost pile. Why? It will absorb odors and discourage flies. Your family, friends, and visitors will appreciate it.

Monitor Moisture

- Add moisture as you BUILD the pile
- Add moisture as you TURN the pile
- If too wet, turn (without adding more water)
- If still too wet, add dry "browns" to pile while turning

Why? Because microbes require moisture to survive, but too much moisture will create odor problems and slow the composting rate.

Monitor Temperature

If you are using a hot composting method:

- Turn if the pile is less than 100°F
- Turn if the pile is more than 150°F

Why? Because the Thermophilic bacteria prefer temperatures in the 105-140°F range, and these microbes are the fastest at converting raw materials to compost.

If the compost pile exceeds 155°F, or so, it may be too hot for the bacteria population to thrive. At higher temperatures the heat may actually kill off part of the population. If this happens, the temperatures will fall off and the populations will slowly rebuild.

Compost thermometers are available for measuring compost temperature.

Mixing & Turning Compost

The compost pile should be mixed and/or turned periodically, depending on how quickly and completely you want your compost to breakdown. Turning is also the first line of defense for any problems that may occur during the composting process. You can use a pitchfork, shovel or specialized tools for this purpose.

Turning has many benefits, including:

- Adds Oxygen
- Helps Destroy Undesirables
- Reduces odor problems
- Breaks up clumps and layers

Turning Adds Oxygen

Turning adds oxygen to the pile. Aerobic composting organisms need oxygen to survive. By building your compost pile with the right balance of greens/browns, providing moisture, and keeping oxygen available to your compost microbes, your pile's temperature will rise and your material will decompose rapidly.

(note that shortly after turning the pile temperature may drop, if the pile is getting "too" hot, you can turn it to help moderate temperature).

Turning Helps Destroy Undesirables

Turning helps destroy undesirables such as weed seeds, insect larvae, and disease-causing organisms by exposing them to the lethal temperatures at the center of the pile. Turning also helps maintain the active population of beneficial microbes by providing more food at the active center of the compost system.

Turning Reduces Odor Problems

Bad odor is an indication that there is an imbalance in your compost system. Turn the pile at the first sign of offensive odor or ammonia smells.

Turning Breaks Up Clumps and Layers

Clumping or matting down can cause pockets in your compost system where oxygen cannot penetrate. These spots can go "anaerobic" which means that microbes that don't need oxygen are doing the work of composting. Anaerobic microbes produce smelly gasses as a by-product of decomposition. Turning breaks up clumps and matted layers in the compost and allows oxygen to penetrate. Therefore, to create a better end product, break up all the clumps of material when turning the compost.

Finishing/Curing

Many people wonder how to create finished compost if they are always adding materials to the compost bin. The secret is to make composting a batch process. After a while of composting in one bin, set the compost aside to finish the composting process for "curing" period.

Curing or "finishing" is the process of allowing materials in the compost system to finish the composting process at lower temperatures. Earthworms and other invertebrates will assist with this process. Make sure the compost is moist and aerated during the curing period, which can be as short as one month or as long as a year or more.

While one batch of compost is curing, you can start a second composting bin for your active composting process. In this manner, you can make your compost and use it too!

Screening Compost

Your composting system may not break down all the larger materials, such as corncobs or wood chips, in the first batch of compost that you make. When you screen your compost, any material larger than your screen size can be removed. These materials are called "overs" which can go back into the compost system the next time that you build a pile. The overs provide bulk for aeration and microbes attached to these pieces will help jumpstart the new composting process.

VIII. How to Use Compost

There are many ways to use compost. Some of the most common uses of compost include:

- Soil Amendment
- Mulch
- Potting Mix
- Compost Tea

Compost as Soil Amendment

Use compost as a soil amendment to increase the organic matter in the soil. Organic matter is critical for plant development and growth. Tropical and subtropical soils are notorious for their lack of this material. Whereas temperate soils may have up to 50% organic matter, sub-tropical soils typically have 1% or less. Compost can help raise organic matter in soils.

Because tropical and subtropical soils never freeze, microbial activity continues year-round. As a result, organic material is used up quickly. Because of biological soil activity and year-round warm weather, gardeners are advised to apply compost annually, or as needed, to increase soil organic matter content.

For best results, use only finished compost as a soil amendment. Compost used as a soil amendment should be applied and incorporated into the soil before planting crops, grasses, plants, etc. Apply 1-3 inches of compost to the soil surface and work it in to the soil to a depth of about 3-4 inches.

Unfinished Compost

Using unfinished compost as a soil amendment may stress plants, causing them to yellow or stalling their growth. This is because the decomposition process is continuing near the plant roots and the microorganisms in the compost are competing with the plants for nitrogen. You may want to compensate for this nitrogen imbalance by adding nitrogen fertilizer to soil applications of immature compost.

As an alternative, use compost as a mulch, and you don't have to worry about whether the compost is "finished" or not. This is because any additional decomposition is occurring above the root zone. The plants still benefit from the compost. See also *Mulch*.

Compost as Mulch

The forest floor is a natural composting system in which leaves are mulch on the soil surface, and then gradually decompose, recycling nutrients and conditioning the soil. Likewise, yard debris such as leaves, grass clippings, or shredded branches can be used as mulch in the landscape and allowed to compost on the soil surface. Over time, the mulch will compost in place.

Finished or unfinished compost can be applied as a mulch 3-4 inches thick on the soil surface. Do not incorporate into the soil. Keep compost mulch 2-3" away from plant stems. Nutrients will filter into soil, without robbing nitrogen from the root zone. Similar benefits as regular mulch: soil moisture retention, insulates soil from extreme temperatures, breaks down to provide nutrients and organic matter for soil structure. One disadvantage to using compost as mulch is that it will not act as a barrier to weed growth, but, in fact, will promote weed growth if not covered with a standard mulch material. Compost or mulch should be reapplied yearly to replenish the decomposing layer.

Compost as Potting Mix

Compost can be used as an excellent potting soil for your container nursery. Compost offers good water retention qualities and some basic nutrients. However, gardeners should use only fully decomposed (called "finished") compost as a potting mix.

Container grown plants need a potting soil that retains moisture, but is well drained. Most gardening enthusiasts blend compost with coarse sand, perlite, vermiculite, etc. to make optimal planting media.

If your compost still has large chunks in it, but is otherwise finished, you may want to screen compost through a 1/2" screen to remove un-decomposed material that could rob nitrogen from the plant roots. Leaving some coarse or bulky material in the mix will help maintain a well-drained planting media.

Caution: If the organic materials have not completely decomposed, plants growing in the compost media may turn yellow and appear stressed. This is because the decomposition process is continuing near the plant roots and the microorganisms in the compost are competing for nitrogen..

Compost as Tea

Compost tea is a method of using your compost nutrients for indoor plants, potted plants with no room for additional soil, and foliar applications (spraying on plant leaves).

To make compost tea, follow this procedure:

Step 1 - Fill a woven bag (e.g., burlap) with finished* compost.

Step 2 - Place the bag in a barrel or bucket of water.

Step 3 - Let sit an hour.

Step 4 - Remove the bag.

Step 5 - Use the resulting liquid, "compost tea" to water plants.

Step 6 - Empty the contents of the bag into the garden and use as compost mulch or soil amendment.

Compost Tea Benefits

Compost Tea extracts nutrients and microorganisms from the compost and allows you to apply these beneficial components to plants. Therefore, compost tea acts as a weak liquid fertilizer, low in nitrogen but high in micronutrients.

If your plants are container grown, there may be no room to add compost to the pots.

Additionally, soil should not be built up against the stems of many plants. Therefore, compost tea is a good option for applying the benefits of compost to container grown plants.

*Using unfinished compost is not recommended due to possible pathogens and compounds which could damage plants. Only finished compost should be used.