Making Compost for Use in Tree Nursery Container Production

Compost is any organic matter that has been broken down over time through the action of microorganisms.

Microorganisms use the carbon in decaying matter as their food source.

Any organic matter that is readily consumed by micro-organisms can be used to make compost.

Phases of the Compost Process

There are 3 distinct phases the as compost process.

These are:

1.) Hot Phase

2.) Cool Down Phase

3. Maturation Phase

Hot Phase: During the hot phase the digestive processes of the microorganisms cause the temperature of the compost pile to increase. Internal temperatures of 130° - 140° are routinely reached. These temperatures are sufficient to kill some disease organisms and weed seeds.

Cool Down Phase: During the cool down phase fungi become more active in the compost processes. This is when stems, stalks and other tough fibrous materials are broken down.

Maturation Phase: The maturation phase begins after the compost has cooled down. In some instances worms move into the compost breaking down some of materials and mixing the compost. The compost is ready to use as soon as most of the original material is no longer recognizable.

While the process of decomposition will occur naturally without any assistance from us, several factors can be managed to accelerate the compost process.

These factors include:

☑ Nutrient Supply
☑ Type of Organic Material
☑ Size of Compost Pile
☑ Particle Size
☑ Available Oxygen

☑ Nutrient Supply and ☑ Type of Organic Material

Organic materials are the food source of the bacteria, fungi and other microorganisms that produce compost.

Compost is the end product of these digestive processes.

Compost that is suitable for growing seedlings requires a mixture of dry dead materials with living green materials.

Dry dead materials are consumed slowly and contain high levels of carbon but low levels of nitrogen.

Living green materials are consumed quickly and contain low levels of carbon but high levels of nitrogen.

If there is too much nitrogen in the compost, some of it will turn to ammonia that will be lost.

The balance of carbon rich dead materials and nitrogen rich green materials is referred to as the Carbon/Nitrogen ratio.

The optimum carbon to nitrogen ratio is about 30 to 1.

Grass, animal manures and fresh green plants are high in nitrogen.

Leaves, brush, sawdust and wood chips are all good sources of carbon.

Blending these carbon sources with nitrogenous materials can provide a satisfactory carbon to nitrogen ratio.

☑Size of Compost Pile

A desirable size for a compost pile for a non-mechanized operation is 8 ft wide and 4 ½ ft high.

If the pile is much larger then air circulation will not be sufficient to ensure the speedy decomposition of the organic materials.

If they are too small compost piles will not develop the heat required for speedy decomposition.

Compost piles should not be less than 3 ft by 3ft.

☑Particle Size

Reducing the size of the organic material prior to composting increases the surface area available to microorganisms.

Reducing particle size also improves the internal structure of the compost pile which makes controlling aeration and moisture easier.

Size reduction can be mechanized with power choppers, shredders or hammer mills.

A small gasoline powered shredder can process up to 250 ft^3/hour of organic materials. This could process enough compost for a nursery that produce 1 million seedlings/year.

☑Available Oxygen

Most microorganisms active in composting require oxygen to live.

These microorganisms are considered aerobic.

The CO_2 that is produced during decomposition needs to be removed.

If not enough oxygen is available anaerobic microorganisms will thrive and slow the decomposition as well as producing a bad smell.

Oxygen will move into the pile if it is loose and there is plenty of space between particles, as when straw is mixed in the pile.

These factors have been quantified and are considered the basic requirements for accelerated compost production.

Quantified Basic Requirements for Accelerated Composting

Requirement	Value
C/N ratio	25 to 35/1
Particle size	3/8″ for agitated and forced aeration
	2″ for windrows and natural aeration
Moisture content	50-60%
Air flow	20- 60 cu ft air/day/lb volatile solids during hot phase, or maintain oxygen level at 10-18%
Temperature	130° - 140 F held for 3 days
Agitation	No agitation to periodic turning in simple systems; short burst of vigorous agitation in mechanized systems
pH control	Normally none necessary
Heap size	Any length, 4 ½ ft high and 8 ft wide for heaps using natural aeration; with forced aeration, heap size depends on need to avoid overheating

Source: Dalzell et. al., 1987

The basic requirements for accelerated composting are:

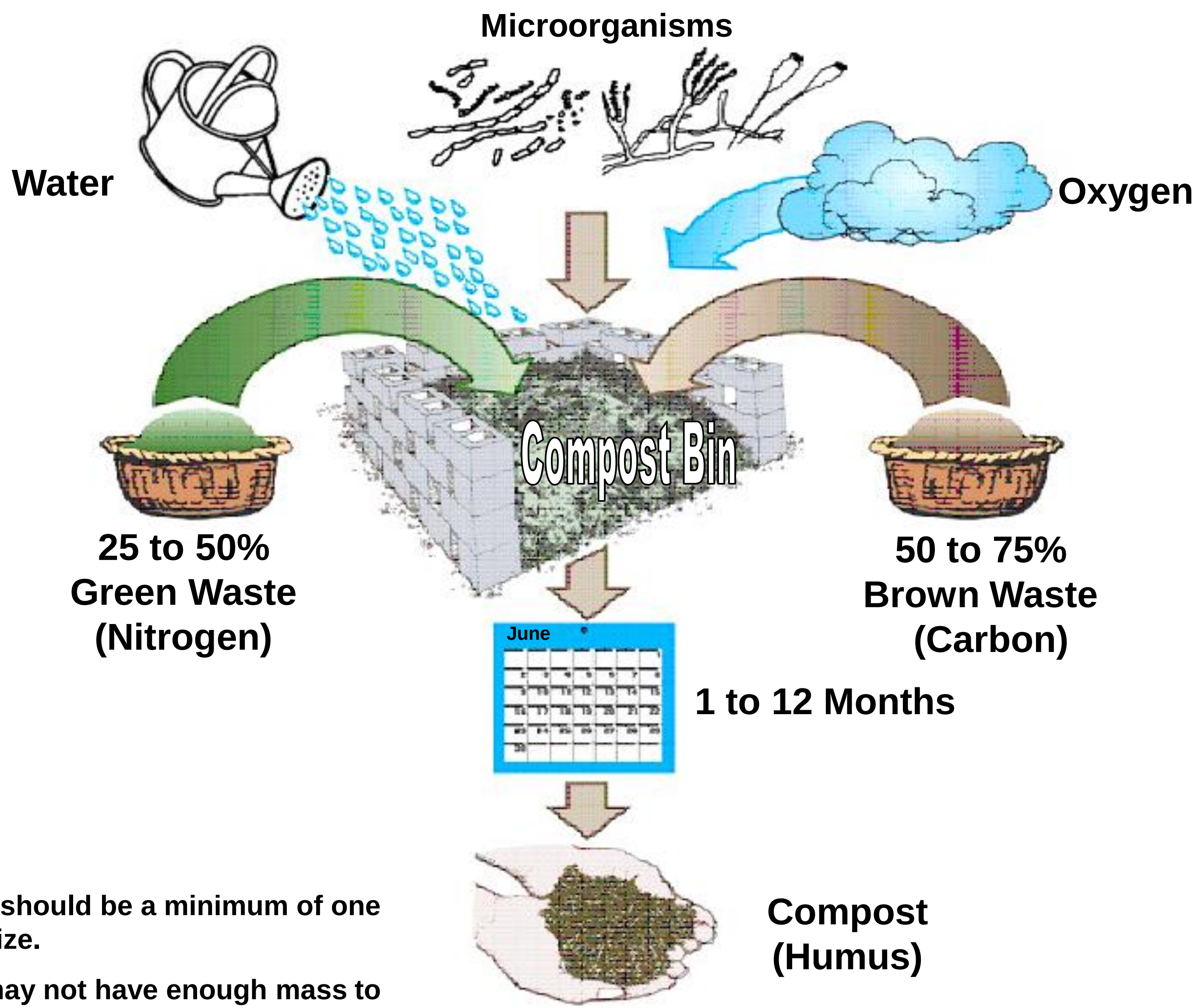
Organic Matter,

25 to 50%
Green Waste
(Nitrogen)

50 to 75%
Brown Waste
(Carbon)

Water, &

Oxygen.



Compost piles should be a minimum of one cubic yard in size.

Smaller piles may not have enough mass to hold the heat of decomposition.

Source: Landis, et. al., 2008

Testing Compost Maturity

Immature (unfinished) compost may stunt or kill plants.

There are several simple tests to determine compost maturity before using compost as a growing media or incorporating compost into a potting mix.

Two tests will be examined:

Plant Germination in Compost

Plant Germination in Compost Extract

Testing Compost Maturity

Plant Germination in Compost

This simple test consists of germinating radishes directly in the compost.

1.) Fill 2 pots with the compost to be tested.
2.) Moisten each pot thoroughly.
3.) Plant 50 radish seeds in rows in each pot.
4.) After 7 – 10 days count the number of seed that have germinated.
5.) If 75% or more of the seed sprout and grow, then your compost is mature and ready to use.

Testing Compost Maturity

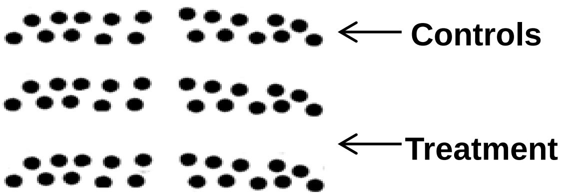
Plant Germination in Compost Extract

This test consists of germinating radishes on paper towels that have been moistened with a liquid extracted from the compost to be tested and with water for a control.

Making the Compost Extract

1.) Measure ½ cup of compost.
2.) Put this compost into a 1 quart jar with a lid.
3.) Measure 1½ cup of clean water add this to the compost in the jar.
4.) Secure the lid onto the jar and shake it. Allow this mixture to soak for 2 hours.
5.) After 2 hours, strain the contents of the jar through a cheese cloth filter into a clean jar.

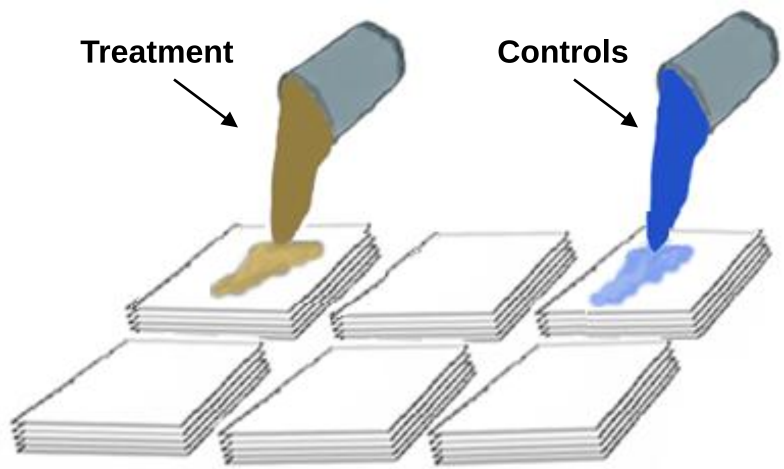
Testing the Compost Extract



5.) Divide the test seeds into six groups of ten.

Two of the groups will be treated with water serve as controls and.

Four of the groups will be treated with the compost extract.



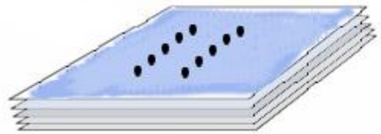
6.) Make six ⅛” stacks of paper towels.

Moisten 4 stacks of the towels completely with the compost extract.

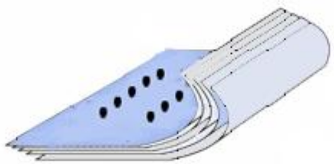
Moisten 2 stacks of the towels with water

7.) Drain of any excess moisture.

Testing the Compost Extract



8.) After moistening the paper towels place 10 seeds on each of the stacks.



9.) Fold the paper towels over the seeds.

10.) Place the folded paper towels into a re-sealable plastic bag.

11.) Place the bags with the seed in a dark space with the temperature at 80 F.

12.) After 24 hours remove the paper towels from storage and count the number seeds that have germinated. Record this number and repeat this process each 24 hours for a total counts (72 hours).

Evaluating the Germination Test

Number of seeds germinated						
Treatment		24 Hours	48 hours	72 Hours	Total Germination	
Control (water)		_	_	_	_	
		_	_	_	_	
		_	_	_	_	
Compost Extract		_	_	_	_	
		_	_	_	_	
		_	_	_	_	

Desirable Soil Characteristics for Container Production

How well a soil meets the needs of the plants being grown is determined by the soils physical and chemical properties. These physical and chemical properties relate to Soil Function and Soil Characteristics.

Soil Function

Potting soil has 4 main functions.

1.) Physical Support: The soil must be substantial enough to hold the plant upright.

2.) Aeration: Plant roots require oxygen. The soil should be porous enough to allow the free flow of oxygen into the soil and CO_2 out of the soil.

3.) Water Supply: Plants need water to grow and the soil must supply the water plants need.

4.) Mineral Nutrient Supply: The essential nutrients that plants need for growth are obtained from the soil.

Desirable Soil Characteristics for Container Production

Soil Characteristics

Bulk Density: Bulk density is the weight per unit volume of a soil and is a measure of soil compaction. As the bulk density of a soil increases, the porosity of the soil decreases. In general the soil for small volume containers should be light weight and the soil used for large volume containers should be heavier.

Porosity: Determines how much space or is available for air, water, and root growth. Soil porosity is composed of both large (macro) pores and small (micro) pores. Large pores are needed for aeration and small pores are needed for holding water. Porosity is a of soil aeration.

Water-Holding Capacity: Water-holding capacity is a measure of the total pore space that remains filled with water after gravitational drainage. A desirable soil will have a high water-Holding capacity but will also have good drainage to prevent the soil from becoming water-logged.

Cation Exchange Capacity: The ability of a soil to chemically hold positively charged ions is expressed as it’s CEC. Plant roots pick up nutrients by exchanging cations for nutrients. The CEC of a soil is a measure of the soils storage capacity. The higher the CEC the less often fertilizer will need to be Applied. In situations where frequent watering is required Nutrients will be leached from the a soil with a low CEC.

Preferred Compost Characteristics for Container Growing Media

Parameter	Value Range
pH	5.5-8.0
Moisture content	35-55%
Stability	½ “ screen or smaller
Stability	Stable to highly stable; provide nutrients for plant growth; no substantial shrinkage
Maturity/Growth screening	Demonstrated ability to enhance seed germination and plant growth
Soluble salt concentration	3 dS (mmhos/cm) or less

Incorporating Compost into Container Mixes

Where they are available commercial soil mixes are generally preferred for growing seedlings.

Compost is an excellent organic component for a nursery soils.

Compost is rarely used alone as a soil medium because they are too porous and soluble salts levels are too high.

Compost enhances soil physical and chemical characteristics by increasing porosity, water-holding capacity and CEC.

Compost has been shown to decrease the incidence of some plant diseases.

BEFORE ADOPTING A NEW SOIL MIX FOR NURSERY PRODUCTION IT IS IMPORTANT TO CONDUCT GROWTH TRIALS TO DETERMINE IF THE SOIL MIX IS SUITABLE.

Incorporating Compost into Container Mixes

If your current soil mix contains peat moss, it is possible to make a 1:1 substitution of compost for the peat moss. A trial of this soil mix is critical before adopting the mix into full production.

It should be noted that most peat-based greenhouse mixes have lime added to raise the pH of the growing media, since peat pH values are very low (3.5-4.5).

When compost substitutes for peat in the potting media, there is no need to add lime since most compost pH values are near neutral to slightly alkaline (7-7.5).

Composts may contain plant nutrients like nitrogen and phosphorus, but these are relatively small amounts.

It is recommend that the same fertilizer application rates used for peat only-based mixes be included when substituting compost.

If you choose to develop your own soil mix it is important to include growth trials and the involvement of a nursery specialist.

The most basic proven soil-less potting mixture was developed by Cornell University in the 1960's.

Standard Cornell Soil-less Potting Mix:
6 cu. ft. peat moss, expanded to about 10 cu. ft.
12 cu. ft. vermiculite (two 6 cu ft bags)
10 lb. dolomitic limestone
3 lb.10-5-10 fertilizer

This mixture is used in the greenhouse production of many ornamental plants. It is a light soil that dries out quickly. Because of this it is not practical for large the volume containers commonly used for growing tree seedlings.

Note that this mixture contains 3 pounds of fertilizer.

A commonly used self-mixed potting soil is similar to the Cornell soil-less, but incorporates soil.

Modified Cornell Potting Mix Using Soil:
6 cu. ft. mature compost.
6 cu. ft. Top soil
3 lb.10-5-10 slow release fertilizer

The main drawback of using soil in potting mixes is that it is not a renewable resource.

However, including soil in a potting mix has many advantages.

These include:

Improving physical support.

Water supply (assuming that there is a high clay content).

Mineral Nutrient Supply.

Materials that should not be put in the compost heap

- Material such as plants which have been recently sprayed with pesticides or herbicides
- Meat scraps, as these may attract rats and other pests
- Large amounts of material that is diseased
- Material with hard prickles or thorns
- Persistent perennial weeds. These should be killed by laying out in the sun to dry, or even burning, to avoid them spreading. The dried material or ashed could then be added to the heap.
- Non-organic materials such as metal or plastic