Soil/less Growers Guide

Mediums

Perlite

Perlite is an amorphous volcanic glass that has relatively high water content. In horticultural applications it makes composts and soils more open to air, while still possessing good water retention properties. Perlite is commonly used in hydroponics for this very reason. Because it is neutral in pH, sterile, and light weight it is very practical for container growing and indoor growing. Perlite can be a staple in soil or soil/less mediums mainly due to its superior aeration.

The elemental properties of perlite are as follows:

Silicon 33.8
Aluminum 7.2
Potassium 3.5
Sodium 3.4
Iron 0.6
Calcium 0.6
Magnesium 0.2
Trace 0.2
Oxygen (by difference) 47.5

Net Total 97.0

Bound Water 3.0

Total 100.0

* All analyses are shown in elemental form even though the actual forms present are mixed glassy silicates. Free silica may be present in small amounts, characteristic of the particular ore body. More specific information may be obtained from the ore supplier involved.

Some common uses for Perlite include:

Seed Raising

- Perlite encourages quicker germination, improved seedling growth
- Sow on a well watered mixture of equal parts perlite and sphagnum moss peat or add 1 part perlite to 2 parts of ready-mixed potting compost
- Perlite may also be used 100% provided that it is kept wet at all times by capillary irrigation or an intermittent mist. Sprinkle fine peat over the seeds, and cover with glass or plastic to retain moisture until the seeds have germinated

Potting Compost

- Perlite is held wholly or partly in place or sand or grit in potting compost where it improves aeration, draining and insulation, and also facilitates rewetting. Perlite can be used to open up peat-based or ready-mixed loam compost.
- For soil/less composts mix 3 – 4 parts of sphagnum moss peat with 1 part of perlite (roughly 80/20).
- For loam based compost, mix equal parts of sterilized loam, peat and perlite (1:1:1 ratio) plus limestone and nutrients. You could also use a 1:2:1 mix. Mix thoroughly, then water well after planting, and feed as appropriate.

Vermiculite

Vermiculite has many of the same traits as perlite and has been used in various industries for over 80 years. It is used in the construction, agricultural, horticultural, and industrial markets. Vermiculite is the mineralogical name given to hydrated laminar magnesium-aluminum-iron silicate which resembles mica in appearance. Vermiculite mines are surface operations where ore is separated from other minerals, and then screened or classified into several basic particle sizes. When subjected to heat vermiculite has the unusual property of exfoliating or expanding into worm-like pieces (the name vermiculite is derived from the Latin 'vermiculare' - to breed worms). This characteristic of exfoliation, the basis for commercial use of the mineral, is the result of the mechanical separation of the layers by the rapid conversion of contained water to steam.

The elemental properties of Vermiculite are as follows:

Silicon 38.0
Aluminum 10.0
Magnesium 16.0
Calcium 2.5
Potassium 3.0
Iron 9.5
Titanium 2.0
Oxygen (by difference) 16.0

Net Total 97.0

Bound Water 3.0

Total 100.0

* All analyses are shown in elemental form even though the actual forms present are mixed glassy silicates. Free silica may be present in small amounts, characteristic of the particular ore body. More specific information may be obtained from the ore supplier involved.

Potting mixes with Vermiculite

- Vermiculite in potting compost gives a very light open compost, holding more water and facilitating re-wetting, thereby lengthening the time between watering. Vermiculite also has excellent ion exchange properties which absorb excess nutrients and release them slowly to the plants via the finest root hairs.

- A 50/50 mix of vermiculite and sphagnum moss peat is widely used for greenhouse pot plants and hanging baskets, while a 25/75 mix is generally suitable for bedding plants, nursery stock, etc.
- To improve an existing compost add 20-25% by volume of Vermiculite and mix thoroughly

Peat Moss

Sphagnum is a genus of between 151-350 species of mosses commonly called **peat moss**, due to its prevalence in peat bogs and mires. A distinction is made between sphagnum moss, the live part growing on top of a peat bog, and sphagnum peat moss, the decaying matter underneath. Bogs are dependent on precipitation as their main source of food and nutrients, thus making them a favorable habitat for sphagnum as it can retain water and air quite well. Members of this genus can hold large quantities of water inside their cells; some species can hold up to 20 times their dry weight in water, which is why peat moss is commonly sold as a soil amendment. The empty cells help retain water in drier conditions. In wetter conditions, the spaces contain air and help the moss float for photosynthetic purposes. Sphagnum and the peat formed from it do not decay readily because of the phenolic compounds embedded in the moss's cell walls. An additional reason is that the bogs in which Sphagnum grows are submerged, deoxygenated, and favor slower anaerobic decay rather than aerobic microbial action. Peat moss can also acidify its surroundings by taking up cations such as calcium and magnesium and releasing hydrogen ions.

Decayed, compacted *Sphagnum* moss has the name of peat moss. Peat moss can be used as a soil additive which increases the soil's capacity to hold water and nutrients by increasing capillary forces and cation exchange capacity (CEC). This is often necessary when dealing with very sandy soil, or plants that need an increased moisture content to flourish. One such group of plants are the carnivorous plants, often found in wetlands bogs for example). Dried Sphagnum moss is also used in northern Arctic regions as an insulating material. Peat moss is also a critical element for growing mushrooms; mycelium grows in compost with a layer of peat moss on top, through which the mushrooms come out, a process called pinning.

Humus

Humus is vital to the growth and health of plants. It brings about balance to the soil and thereby promotes a much healthier plant by increasing the metabolism of a plant's root system. Vigorous plants are better able to fight off disease and insects. Humus delivers what we gardeners really want: higher yields and better quality flowers, vegetables and fruits. Humus is the result of the decomposition of animal and vegetable matter through the action of bacteria. The decomposition process by microorganisms in the soil creates two acids, Humic and Fulvic acids. Humic acids are large molecules that play a major role in maintaining good soil structure and have a great capacity to retain and exchange nutrients. Fulvic acids consist of molecules smaller than those of humic acids and form soluble metals with soil nutrients, thus move vital nutrients from the soil to the plant. Humus also contains several horticulture nutrients: organic calcium, organic nitrogen, bagasses extract, potassium hydroxide, biuret urea and phosphoric acid.

Humus vs. Chemical Fertilizers
Humus has a number of unique properties that differentiates it from chemical fertilizers

- Reduces the amount of chemical fertilizers needed by plants.
- Improves soil structure by increasing its permeability, permitting greater aeration and porosity.
- Increases the capacity of retaining and exchanging nutrients.
- Increases the cellular activity, stimulating balanced growth of plants by improved germination of seeds, greater root development, higher chlorophyll content, and higher vitamin content.
- Increases permeability of the cellular membranes resulting in higher absorption of nutrients through both roots and leaves.
- Encourages the development of beneficial soil microorganisms.
- Unlocks the nutrients in the soil so that they can be assimilated by the plant.
- Stabilizes pH.

Composting

Introduction

The basic ideal behind composting is to turn fertile soil and excesses into a horticultural humus which can be used as excellent organic fertilizer. By feeding your plants organic materials such as compost will result in healthier plants, and most overlooked, happy soil. Depending on the ingredients added into the compost, the grower can manipulate their compost pile to benefit the needs of their garden. There are a few things to keep in mind when adding to your compost pile if you're looking to optimize your eventual nutrients.

First of all, **C/N ratio** (Carbon to Nitrogen ratio) is very important in maximizing the potential of your compost pile, an ideal ratio would be 25-30:1. This is done usually by adding two parts significant Carbon contributors with one part Nitrogen dominate substance. I will post a list later of each, but by doing some basic math, you can equate your mix to get it within 25-30:1.
Secondly, there are two methods in which to process your compost: **Active** and **Passive** methods.

1) **Active**

Hot thermophilic composting is essential with some materials to kill pathogens. This method is not recommended for indoors as it has the tendency to get smelly (however, a system such as the composter diagram could easily be adapted into a grow room with no negative repercussions). These piles can work well if you're looking for a way to positively use that hot HID air, as the primary aspect of this process is active airflow from fan pushing air and intermittent mist through your pile. The compost should maintain a 50% moisture level or similar to that of a sponge. An ideal temperature for an active compost pile is roughly 60 degrees F for a minimum for 3 weeks. The natural sequence of the decomposition community involved will be:

~ 0-15°C (32-59°F) - psychrophiles
~ 15-40°C (60-104°F) - mesophiles take over, psychrophiles die off or are relegated to the borders
~ 40-70°C (105-160°F) - thermophiles

predominate, beginning the heating process as they multiply work at their peak, including consuming many other bacteria
At the lower temperatures and around the borders, there will also be various fungal activity as well as larger organisms getting their share. A very dry, cooler

pile may be attractive to ants, and gastropods (like slugs) may visit very wet piles. As the temperature returns to ambient at the end of the process, the sequence reverses, including new organisms that prefer the more degraded materials. Added heat and pile insulation may be useful in the coldest weather, but is not ordinarily necessary, and is not desirable if it interferes with aeration or natural convective evaporation. Usually keeping the top dry and burying fresh additions in the center of a pile will be effective during winter conditions until heating resumes in spring.

2) **Passive**
Cool or ambient temperature composting, when the level of physical intervention is minimal, usually results in temperatures never reaching above 30°C (86°F). It is slower but effective, and is the more common type of composting in domestic gardening. Such composting systems may be in open or closed containers of wood or plastic, or in open exposed piles. Kitchen scraps are put in the garden compost bin and left untended.

This scrap bin can have a very high water content, which reduces aeration, and may become odorous. To improve drainage and airflow, and reduce odour, wood chips, shredded bark, leaves, or twigs may be added to mix and cover each wet addition. The pile should be mixed 3-4 times weekly and just enough to mix the compost for aeration. Always add new supplements to the interior of your compost for better decomposition. The amount of attention may vary from none through occasional to "regular".

Additives and Specifications

The general rule of thumb is that green clippings (grass, weeds, fruit and vegetable scraps, etc.) tend to carry higher Nitrogen amounts, whereas brown or darker vegetation tends to be higher in Carbon. Here is a basic list of items that can be used in compost piles, compiled with C/N ratios for your convenience:

Organic Compost Materials	C/N Ratios
Alfalfa Hay	12 : 1
Food Scraps (table scraps)	15 : 1
Grass Clippings (no herbicides used)	19 : 1
Rotted Manure	20 : 1
Legume-Grass Hay	25 : 1
Leaves (houseplants, cannabis)	40-80 : 1
Straw	80 : 1
Paper (shredded, slow release)	170 : 1
Sawdust	500 : 1

I'm currently still working out a complete comprehensive list of 50 – 100 organic compounds that can be mixed into composts to benefit soil and root growth and development, I'll get there soon.

Making Your Compost Pile

A general guideline is to use 1/3 green material and 2/3 of dry material. Form a heap by alternating 4- to 6-inch layers of dry carbon materials with 2- to 3-inch layers of green nitrogen material or animal manure. Add a layer of your soil for each layer of compost material and give each layer of soil a thorough misting to make sure it's damp. You cannot have decomposition without moisture! The air and moisture is the key to composting so it is important that air be added to the heap by regularly turning and mixing the materials. The first turning should be three or four days after the heap is formed, and subsequent turnings once a week. Use a spade (or like me, your hands) to fluff and mix the ingredients. Large heaps can be turned by removing the top layer and using it as the base for a new heap. As ingredients are moved from one heap to the new one, air is incorporated.

Failure of the heap to heat up in a few days indicates the decay process has not started. Add more nitrogen materials and be sure that the heap is sufficiently moist, a great nitrogen material for supplementing is coffee grounds. They tend to carry a 2.3-2.3-0.2-0.3 N-P-K ratio and they work great to initiate decay once they are warmed to 300 degrees C in the oven for 10 minutes. Compost that smells strongly of ammonia or is slimy requires more frequent turnings and the addition of high carbon materials. How soon compost is "finished" will depend on the size and balance of the ingredients used, the air temperature, and how fast decomposition was encouraged by keeping the heap moist and turning it regularly.

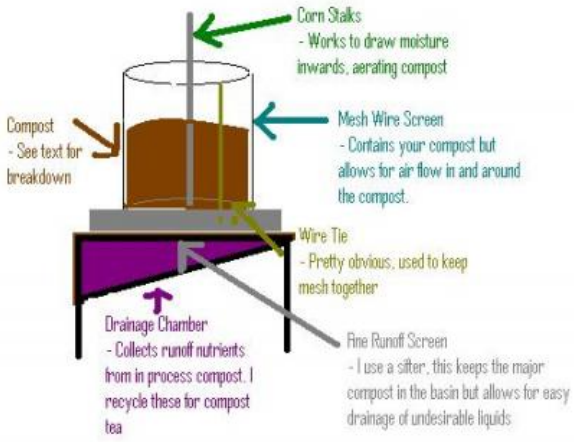
My compost pile goes as follows:

Organic potting soil - 25L
Cannabis leaves (Green and Brown) - 2 Oz.
Alfalfa Hay - ¼ lbs
Worm Castings - 5L
Bat Guano - 5L
Baked Coffee Grinds - 1 lbs

This compost recipe makes me about 30L which is nearly 8 Gallons if my math is right, I'm stoned though … That's about enough to feed an entire cycle of plants from seed to harvest for me (6-8 plant cycles). I'm sorry about the weird units of measurement but that's how I know how to equate them easiest without getting crazy with math. The whole process takes me about 4-6 months with 2 alternating compost piles to ensure rapid burning with constant fresh nitrogen

Building Your Compost Pile

I have included a diagram of what my compost essentially looks like and what it includes (pardon my lack of skills in paint, I wish I was back in third grade and could focus on that 🙂). I've broken down a compost recipe above to display the brown portion; the rest is pretty self explanatory. I place 1 Gallon pots below my runoff tray to catch and preserve the nutrient rich runoff. The whole system (both containers side by side) cost me collectively $12.00 CDN at Home Depot. The cheapest, most effective nutrients one can get is right under your noses, be thrifty everyone, more times than not your organics can be reused for good.



Vermicomposting

Vermicomposting Basics

In a nutshell, vermicomposting is a cooler composting process involving the joint action of earthworms and microorganism (with a few other helpers as well). It is my personal favorite composting method, given the versatility and benefits of this strategy. It is important to mention that only certain kinds of worms can be used effectively for vermicomposting - those specialized for a warm, crowded life in rich organic environments. These are what I refer to as the 'composting worms'. Probably the most widely used and known worm for vermicomposting is the 'Red Worm' (also known as 'Red Wigglers'), *Eisenia fetida*, but there are also others such as the European Nightcrawler (*Eisenia hortensis*), the African Night crawler (*Eudrilus eugeniae*), and the Blue Worm (*Perionyx excavatus*).

Worm composting is a great option since it can literally be done on any scale. No heating is required (in fact, you want to discourage any heating of your composting materials, since this can harm the worms), so you don't need the 'critical mass' mentioned above. This is an ideal composting method for those who don't have a lot of space, but still want to produce a nice compost for their plants.

In technical terms, worm composting involves the bioxidative degradation of organic wastes via the joint action of earth worms and microorganisms. Geeky definitions aside, worm composting is simply a form of aerobic composting that involves the use of specialized worms to help break down organic waste materials. It is also known as 'vermicomposting', and is closely related to 'vermiculture' and 'worm farming' - although those terms general imply a great focus on the growing of the worms themselves, rather than on the waste processing and compost production side of the equation.

How is Vermicomposting Different from Normal Composting?

Aside from the obvious difference of utilizing worms while regular composting does not, worm composting is also a cooler (mesophilic) type of composting. Not only is a hot composting stage not required, but it is actually something that needs to be avoided in order to keep the worms alive (although, if the system has enough room for the worms to spread out they should be able to move away from the hot zones).

Here are some other differences:

Worm composting…

- Is a ‘continuous’ composting process - materials are generally added on an ongoing basis, unlike the ‘batch composting’ approach used for hot composting
- Can be done on any scale - both indoors and outdoors
- Results in an incredible compost (vermicompost / worm castings) with unique plant growth promotion properties - at little goes a long way!
- Doesn’t require any turning of material - the worms accomplish this themselves
- Can handle more moisture (again, worm movement helps to keep things aerobic)

Which Kind of Worms Can I Use?

Many people assume that you can use any type of worm for worm composting. This is in fact not the case. Effective vermicomposting requires the use of specialized earthworms - species that are adapted for life in and amongst rich organic waste materials, and warmer, crowded conditions. Just as regular soil worms won’t do all that well in a worm composting system (although they certainly can be found in the lower reaches of outdoor sytems), composting worms don’t generally do very well in normal garden soil, unless of course a considerable amount of organic waste has been added.

Undoubtedly the most common species of worm used for composting is ***Eisenia fetida*** - the ‘Red Wiggler’ worm, also known as Red Worms, Brandling Worms, Manure Worms, and Tiger Worms (among others). This worm can vary widely in terms of coloration and size, which helps to explain why there are so many common names. This also highlights the important of using scientific names! This species is incredibly versatile - it has a temperature tolerance ranging from 0C (32F) to 35C (95F), is a prolific breeder, and will readily feed on a wide range of organic waste materials (more specifically, on the microorganisms inhabiting the material, but we’ll chat more about that further down).

There are a handful of other worms used for vermicomposting as well. Generally, they are tropical worms and just don’t have the versatility (for a number of reasons) that the above-mentioned species do - especially not in cooler regions of the world. Just so you know, two commonly used tropical species are *Eudrilus eugeniae* (the African Nightcrawler) and *Perionyx excavatus* (the Malaysian Blue Worm).

Starting a Vermicomposting System

Starting up your own worm composting system is a very simple process. There are 4 basic requirements for getting a worm system up and running:

1) A container
2) Some sort of 'bedding'
3) Organic waste materials, and last but certainly not least –
4) Composting worms.

I highly recommend that newcomers start by focusing on the first three well before getting worms. It is important to remember that, while you *are* trying to compost wastes, you are also trying to keep your worms alive and happy. A great way to do this is to create an ideal habitat for the worms to live in - something I'll talk further down the page. If you are interested in a quick and dirty demonstration of how you can set up a worm composting system, here's a video I made that you may find useful (this one features a 'deluxe' system, but I also made another video featuring a more basic design):

Container

The container you use for your vermicomposting certainly doesn't need to be an expensive, fancy system. There are a wide variety of inexpensive options out there, and who knows - maybe you won't even need to leave the house to find something functional.

I personally prefer using Rubbermaid (TM) plastic tubs (with lids) for my indoor bins. They are very inexpensive, lightweight, and retain moisture very well. Even though I made (and now use) the bin in the video above, for the most part I like to keep things simple by using just one basic bin - although there definitely *are* advantages to having drainage holes and a reservoir bin below. Regardless of what sort of system you settle on, there are a few things to keep in mind during the selection process. For starters, your bin should be opaque (i.e. *NOT* 'see-through'). Worms are sensitive to light, thus a clear system may end up causing them unnecessary stress. I tried making an aquarium into a worm composting system once, and while it was pretty darn cool to be able to watch the decomposition process, I ended up feeling pretty badly for the worms. They were basically trapped in a poorly oxygenated system where they couldn't even come to the surface or along the walls - except at night (when I would see masses of them along the glass).

Also, if you are going to use a plastic system I would suggest using something fairly soft - not the really hard plastic. The latter variety of tub seems to crack more easily, especially if located outdoors.

Bedding

Bedding is essentially the main component of the ‘habitat’ in a worm bin. The distinction between bedding and worm ‘food’ is a little misleading however, since in actuality bedding is simply a longer term food source.

Bedding materials tend to be carbon rich and absorbent, so they are important for helping to maintain some balance in the bin.
Excellent bedding materials include shredded cardboard, shredded newsprint, peat moss (although not necessarily the most environmentally friendly), coconut coir, well-aged manure, mature compost, straw, and fall leaves. I personally prefer to use the bulkier bedding materials, such shredded cardboard, since they help to encourage airflow in the bin, but combining bulky materials with some of the more absorbent materials (like coir, or aged manure) can provide you with the *ultimate* worm habitat.

It should also be mentioned that less absorbent materials like leaves and straw, while certainly great additions to any worm composting system, are better used as secondary bedding materials since they simply won’t hold water nearly as well as some of the other bedding substrates mentioned above.
Aside from the large quantity of bedding added when you first set up a bin, it is also not a bad idea to add a small amount each time you add food scraps as well, since this will help absorb excess moisture and ensure that the C:N doesn’t get too low (which could result in the release of ammonia gas).

Worm Food (Organic Waste)

There are a wide variety of organic wastes that can be successfully processed via vermicomposting, but some materials are definitely better suited for a worm bin than others.

Great Choices

- Fruit & Vegetable Waste
- Coffee Grounds
- Tea Bags
- Egg shells (best if crushed)
- Well-aged manure

In Moderation

- Starchy Materials - Breads, Rice, Pasta, Mashed Potatoes
- Citrus fruit and peels
- Grass Clippings and plant waste (assuming no pesticides applied)
- Hot peppers, onions
- Oily or sugary foods

Not Recommended

- Human and Pet Waste
- Meat
- Dairy
- Excessively oily foods

Keep in mind that these are simply basic guidelines, and there are many exceptions across the board. These lists apply primarily to vermicomposting newcomers who are setting up a small indoor worm bin. Using various specialized vermicomposting systems and with more vermicomposting experience, the range of “great choices” certainly expands.

It should also be said that moderation and balance are really the key to successful vermicomposting - i.e. Just because rotting lettuce is an excellent material to feed your worms, it doesn’t mean you can fill your bin completely with it and expect great results. You still need to balance the “browns” (carbon-rich) with the “greens” (nitrogen-rich) - the wet with the absorbent etc.

Preparing Your System for the Arrival of Worms

If you watched the video posted above, you should be fairly familiar with my recommendations for setting up a new bin. I thought it might not be a bad idea to included written instructions here as well.

As mentioned earlier, it is important to remember that we should be trying to create an ideal 'habitat' for our little wiggly friends, so that they remain as healthy (and thus as efficient) as possible. Many people recommend simply setting up a worm bin once your worms arrive - I don't personally agree with this idea, since it basically means you are introducing your worms into a fairly sterile environment. While we tend to think of worms as feeding directly on the waste materials that we add to the bin, more accurately, they are actually grazing on the microbial community that colonizes (and decomposes) these wastes. Of course, in the process they DO consume some decomposed waste as well, but most of their nutrition is derived from the microbes. As such, it really helps to introduce your new worms into a microbially-rich habitat. Lucky for us, creating such an environment is relatively easy.

My basic method for getting a worm bin ready involves mixing shredded cardboard (my favorite bedding material) with food waste in a volume ratio of approx. 4:3 (bedding to food) - you may want to be a little more cautious if you are just starting out, and simply add a higher proportion of bedding. This mixture is moistened (but not soaked) using a spray bottle, then closed in some sort of plastic container - it doesn't even need to be your actual worm bin. If you are receiving your worms at the same time as your bin, simply mix up the materials in a tub or bucket then transfer to your bin once it arrives. It *does* help if this container has some sort of lid since this will help keep the moisture in.
I prefer to leave this mixture to sit for a good week or two (with occasional stirring and additional misting with water if necessary) since this allows for more decomposition to occur and a larger microbial community to develop, along with a better distribution of moisture in the materials.

This is also a great way to make 'food' for your bin once it is up and running. Simply line the bottom of a bucket with shredded cardboard and store your food scraps (mixed with more cardboard) in it for a period of time before adding them to your worm bin.