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Potting Mixes for Certified Organic Production

By George Kuepper, NCAT Agriculture Specialist, and Kevin Everett, Intern
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By Luke Freeman, Sustainable Agriculture Specialist

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Contents

This publication covers considerations for an organic grower selecting a potting mix to use for transplant or containerized plant production or for someone wishing to blend organic media. This publication discusses individual components of potting media in addition to organic and biological amendments to improve plant performance. Several organic potting mix recipes are included in the appendix, in addition to suppliers of organic media and amendments.

Organic basil transplants are grown in peat-based potting media at Peace Farm Organics. Photo: Luke Freeman, NCAT

Introduction

Potting mix is a critical component in the production of healthy plants for organic farms and nurseries. Most containerized plants grown for transplanting or nursery production are grown in a potting mix or soilless media. Although there are aspects of potting mixes that are universal to all plant production, there are specific considerations for certified organic producers when it comes to selecting or mixing their own potting media. Specific ingredients and amendments must be avoided in organic potting media due to the National Organic Standards, but, more importantly, a good potting mix is critical to growing strong, healthy plants that will thrive in an organic production system.

An ideal organic potting mix will include all of the following physical, chemical, and biological characteristics. It will have pore space to allow for the retention of both air and water and the rapid growth of roots throughout the media. It will be chemically balanced, with the right pH

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and nutrients for plant growth – or the ability to retain nutrients that may be added later in a liquid fertilizer. And it will be biologically active, with the microorganisms needed to mineralize organic fertilizers, suppress plant pathogens, and support the health of the plant.

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Commercial Potting Mixes

Many organic farmers choose to purchase a commercial potting mix instead of making their own. A commercial mix is usually slightly more expensive than the sum of the raw ingredients, but the trade-off in terms of time spent procuring and mixing the ingredients makes it worthwhile for many farmers to buy a pre-mixed blend.

Over the past decade, the number of commercially available organic potting mixes has drastically increased, with most large potting-media companies offering at least one organic mix in their product line. A list of organic potting mixes and manufactures is included in Appendix 1 for your reference. If you are curious about the organic status of a potting mix not found in our list, a good place to start is the OMRI List. OMRI, or the Organic Materials Review Institute, is a third-party organization that evaluates products and processes for the organic industry. If a potting mix bears the "OMRI Listed" label or is listed on the OMRI website (www.omri.org), you can be assured that it is allowed in organic production. The Washington State Department of Agriculture's organic program also maintains a list of allowed products, which can be viewed on its website (www.agr.wa.gov/FoodAnimal/Organic). However, it is still best to check with your certifier if you have any question about allowed substances for organic production.

If you are considering using a commercial potting mix that is not listed by OMRI or the WSDA, read through the ingredient list carefully and make sure that none of the ingredients are prohibited by the USDA National Organic Program (NOP). Common non-organic ingredients in commercial potting mixes are synthetic wetting agents and synthetic fertilizers. Sometimes these ingredients are not listed on the bag, and you may need to contact the manufacturer or refer to the product page on the manufacturer's website to obtain a complete list of ingredients. You will find an in-depth discussion of potting mix ingredients at the end of this publication.

An important consideration of organic commercial potting mixes is that they do not have a long shelf life. Because of the nature of organic wetting agents and biologically alive amendments like compost and microbial inoculants, organic mixes are best used fresh. Plan to use all of the potting mix you purchase within one year to get the best performance.

Selecting the Right Potting Mix

When selecting a commercial potting mix, it is important that you choose a mix that is appropriate

A commercial organic potting media is used by Peace Farm Organics for their transplant production. Photo: Luke Freeman, NCAT

Cell packs are filled with organic media using a mechanized filler at Peace Farm Organics. Photo: Luke Freeman, NCAT

for your intended use. You will be able to find commercial blends formulated for seed starting, growing transplants, and maintaining larger containerized plants, with each blend differing in significant ways.

Mixes designed specifically for seed starting are usually made from screened peat moss so that they are fine in texture and have a very low fertilizer concentration, if any. A seed-starting mix is ideal for germinating seeds in flats or plug trays, but seedlings will need to be potted up into a growing mix soon after true leaves develop. A germination mix can also be used for propagating cuttings.

Growing mixes or "all-purpose mixes" usually contain peat moss, perlite, and/or vermiculite, an organic wetting agent, a liming agent, an organic fertilizer, and an array of organic amendments including compost, worm castings, organic fertilizers, and microbial inoculants. Many growers choose to use a standard growing mix to germinate seeds. This helps reduce the need to pot up young seedlings, but it is important to note that a high fertilizer concentration in the potting mix can inhibit seed germination. If you are selecting a growing mix for germination, choose a blend with a lower fertilizer concentration and plan to add supplemental fertilizer as needed during transplant production.

Potting mixes designed for larger containerized plants are usually coarser in texture and include composted pine bark or other woody material, in addition to the standard components of a

The type of potting mix you select will depend on the types of plants you are growing and the size of containers you are using. Photo: Luke Freeman, NCAT

Table 1. Commercial Organic Potting Mixes

Note: These product listings are provided for informational purposes only. NCAT does not recommend one product over another or endorse any specific product or company.

Company	Name	Use	Ingredients
Berger	OM 2	G, PP	Peat moss, perlite, vermiculite, calcitic and dolomitic limestone, wetting agent*, pelletized organic fertilizer
Lambert	LM-18 Organic Germination Mix	G	Peat moss (80-90%), perlite, calcitic and dolomitic limestone, wetting agent*, organic nutrient charge
	LM-111 Organic All Purpose Mix	G, PP	Peat moss (80-90%), perlite, calcitic and dolomitic limestone, wetting agent*, organic fertilizer
Premier Tech Horticulture	Pro-Mix PG Organik	G	Peat moss (60-70%), coconut coir, vermiculite, limestone, wetting agent*
	Pro-Mix MP Organik**	PP	Peat moss (55-65%), coconut coir, perlite, limestone, and wetting agent*
Sun Gro Horticulture	Sunshine #3 Natural & Organic	G	Peat moss, vermiculite, dolomitic limestone, silicon, organic nutrients
	Sunshine #5 Natural & Organic	G, PP	Peat moss, perlite, dolomitic limestone, silicon, organic nutrients
Vermont Compost Company	Fort-Lite Potting Mix	G, PP	Peat moss, compost, perlite, vermiculite, coconut coir, blood meal, kelp meal, bone meal, gypsum, crushed granite and basalt, and biodynamic preparations
	Perennial Blend Container Mix	WP, LC	Compost, composted maple and birch bark, vermiculite, coconut coir, blood meal, kelp meal, bone meal, gypsum, and biodynamic preparations

G=germination/propagation, PP=plant production, WP=woody perennials, LC=large containers
**organic wetting agent*
***formulations available with mycorrhizae and other microbial inoculants*

Some potting media companies, such as Vermont Compost Company, will offer discounts if commercial media is purchased in bulk. Photo: Andy Pressman, NCAT

potting mix, to provide better drainage and increase porosity. These mixes can also have a higher nutrient concentration, to feed the potted plant for a longer duration than a standard growing mix for transplants.

You will find a list of popular commercial organic potting mixes in Table 1, along with their intended use and list of ingredients. More information on potting-mix suppliers can be found in Appendix 1. Bulk discounts are available from some suppliers, which can help you save money if you purchase a large quantity of mix in cooperation with other growers in your area. In addition, if you are buying in large quantities, you may be able to work with the manufacturer to have them create a custom blend. You may want to check with your local farming organizations, conservation district, and farming neighbors to see if any groups are already participating in a bulk-buying program.

Boosting a Commercial Potting Mix

Instead of creating a custom potting mix from scratch, you may choose to purchase a basic commercial mix and boost it with additional organic amendments. This allows you to save time mixing bulk ingredients, but still end up with a premium potting mix. A basic "peat-lite" mix, composed primarily of peat moss and perlite and/or vermiculite, makes a good foundation for a custom mix. These commercial mixes already have a balanced pH and contain an organic wetting agent to help the peat moss absorb water. A starter fertilizer is usually included in commercial peat-lite mixes, but you may choose to add additional organic fertilizers to reduce the amount of supplemental liquid fertilizer that needs to be applied. Also, high-quality compost and vermicompost can be added to a commercial mix to increase moisture retention, add nutrient value, and provide beneficial microbes to support plant health and speed the mineralization of organic fertilizers. Other biological amendments, such as mycorrhizal fungi and rhizobacteria, can also be added to improve the performance of a commercial blend. You will find a more detailed discussion of these amendments in the section on biological amendments.

Making Your Own Potting Mix

Making your own potting mix is fairly straightforward and can save you money, but it does involve an investment of time and some planning ahead. Also, you will need to have a location on your farm where you can store and mix bulk ingredients. Many organic growers choose to purchase a commercial mix because they have decided that they would rather pay someone else to make a quality product, but if you would like to explore making your own potting mix, here are some things to consider.

A tub such as this can be used to mix small batches of potting mix. Photo: Luke Freeman, NCAT

The Basic Recipe

You will find a list of recipes in Appendix 2, and it is recommended to start from a proven recipe and make adjustments from there. The best recipe for you depends on the ingredients you can access and the intended purpose of the potting mix. As discussed in the context of commercial mixes, whether the mix is intended for seed-starting, growing out transplants, or growing out larger potted plants will determine the ingredients and the proportions.

Traditional potting mixes usually included garden soil and sharp sand, in addition to compost and other ingredients. These ingredients are rarely used in modern organic potting mixes because of the possibility that they could introduce plant diseases into the mix. Once peat moss became widely available as a potting mix ingredient, it mostly eliminated the need to use soil because it was a sterile, effective, and affordable substitute. In addition, modern potting mixes tend to use perlite or vermiculite instead of sharp sand, for similar reasons. If you would like to use soil in your potting mix, it is recommended that you sterilize the soil by heating it to a temperature of 180°F for 30 minutes (Maynard and Hochmuth, 2007). This can be accomplished by using a home oven preheated to 275°F and baking 1-gallon batches of moist soil for 30 to 40 minutes (Bubel, 1988). For commercial production, there are large-scale ovens and steam sterilizers available. Sand can also carry pathogens and other contaminates, so ensure that it is from a clean source and consider heat-treating it as well.

The Cornell peat-lite mix was one of the first soilless potting mix recipes and relies on peat moss as the main substrate. The basic recipe for a peat-lite mix is 50% peat moss with 50% perlite or vermiculite to add porosity and lighten the mix. For every cubic yard of peat moss, 20 pounds of ground dolomitic limestone should be used to balance the pH (Boodley and Sheldrake, 1982). This recipe is well-suited to conventional production, where soluble fertilizers are used to provide for plant nutrition, but it lacks the biological component to assist in the mineralization of organic fertilizers that would be used in organic production.

Many modern organic potting mix recipes are an adaptation of the peat-lite mix that use compost to supplement a portion of the peat-moss component. Compost will add water-holding capacity and structure like peat moss, but it also adds a living biological component that will assist in the mineralization of organic nutrients for plant uptake. Many of these recipes include peat moss, compost, and perlite/vermiculite at a proportion of roughly 1:1:1 or 2:1:1. Coconut coir is sometimes substituted for peat moss, and perlite and vermiculite can be used interchangeably or mixed. Though compost does assist in balancing the acidic pH of peat moss, lime is usually required to bring the pH up to an ideal range. You will find a discussion of the individual components of a potting mix recipe in the following pages.

Workers at Peace Farm Organics pot up tomato seedlings from plug trays into 1204-cell packs. Photo: Luke Freeman, NCAT

Fertilizer Blends

Many organic growers focus on providing for all of the plants' nutrient needs within the media itself. To accomplish this, a blend of organic fertilizers must be added. Compost can provide a significant amount of phosphorus, potassium, sulfur, and trace elements, as well as minor amounts of nitrogen, depending on its quality and age. However, additional fertilizers are needed to ensure adequate supply of all the plant-essential nutrients. An ideal potting mix contains nitrate-nitrogen (N) at 10 to 200 ppm, phosphorus (P_2O_5) above 3 ppm, potassium (K_2O) above 25 ppm, calcium (Ca) above 30 ppm, magnesium (Mg) above 10 ppm, and sodium and chloride below 130 and 200 ppm, respectively (Wander, 2015). By using a recipe that contains a complete fertilizer blend and testing the performance in small batches, you can assess the supply of nutrients without necessarily having to measure nutrient concentration. Two example fertilizer blends are included in the text box on page 6, and you can find a list of common organic fertilizers in Table 2.

Organic Fertilizer Blends for Potting Mix

Eliot Coleman Base Fertilizer Mix (published in *The New Organic Grower,* 1995)

Add 3 cups of fertilizer mix for every 20 gallons of potting mix

- 1 part blood meal
- 1 part colloidal (rock) phosphate
- 1 part greensand

John Greenler Fertility Mix (published in January 1996 issue of *Growing for Market)*

Add 1 ½ cups of fertility mix for every 15 gallons of potting mix

- 2 cups colloidal (rock) phosphate
- 2 cups greensand
- 2 cups blood meal
- ½ cup bone meal
- ¼ cup kelp meal

The availability of organic fertilizers depends on the rate of biological mineralization, which is driven by temperature and the activity of microbes.

You may also find it beneficial to mix your fertilizer blend into the potting mix beforehand and allow several weeks for "incubation." Research on incubation time for an alfalfa-based organic fertilizer found that one to three weeks was an optimal incubation period at application rates of 0.6% to 1.2% of 3-3-3 fertilizer in a peat-based potting mix weight-by-weight (Nair et al., 2011). This incubation period allows time for the biology in your potting mix to begin to break down organic nutrients into forms that are plant-available.

Even if your potting mix contains a complete fertilizer blend, it may be necessary to provide readily available nutrients in the form of liquid organic fertilizers. The availability of organic fertilizers depends on the rate of biological mineralization, which is driven by temperature and the activity of microbes. For example, phosphorus deficiencies can appear in greenhouse transplants in early spring because cold temperatures limit the mineralization of P (Wander, 2015). A Canadian study on pepper transplants found that optimal plant growth resulted from a mix of granular organic fertilizers (shrimp meal and kelp meal) mixed in the media in addition to a liquid organic fertilizer (3-0.4-0.8) applied at watering three times per week (Gravel et al., 2012). A common liquid fertilizer for organic farms is fish emulsion or fish hydrolysate, which usually contains around 5% N, 1% P_2O_5, and 1% K_20. Other brand-name organic liquid fertilizers include Nature's Source Organic™ Plant Food (3-1-1) and Phytamin® All Purpose Fertilizer (3.7-2.7-3.7).

A sifting screen such as this one can help remove large particles from compost used in a potting mix. Photo: Luke Freeman, NCAT

Mixing the Ingredients

When mixing the ingredients for a potting mix, follow the steps below to end up with a consistent and high-quality product. Also, wear a mask to avoid breathing in dust from dry peat or perlite. A concrete mixing tub or large plastic bin can be used to mix the ingredients by hand on a small scale. For larger scales, an electric concrete mixer can be used. It is important to start with premoistened peat moss because peat can be very dusty and difficult to wet if it is handled when completely dry. If you are using a dry bale of peat, you can pre-moisten it with one gallon of warm water for every two bushels of peat (Boodley and Sheldrake, 1982). An organic wetting agent such as yucca extract can be added to the water to assist in the wetting of peat. After the peat is moistened and added to the mixer, the lime and fertilizer blend should be spread over the peat and mixed thoroughly to distribute evenly. Next, the compost, vermiculite, and/or perlite can be added and mixed until combined. Be sure to avoid overmixing once the vermiculite or perlite has been added because these materials can break down if over-handled. As mentioned earlier, letting the mix incubate for one to three weeks at room temperature can be beneficial, but avoid storing the mix for more than one season, as quality will decline. Also avoid letting the mix dry out, because re-wetting dry peat moss can be difficult.

Testing Your Mix

If you are trying new potting mix recipes, it is important to have a consistent process to test the performance and characteristics of the recipes. A low-tech way to test your mix is to conduct a germination test and a pot trial. Seeds such as cress, oats, beans, and lettuce will germinate quickly and are fairly fast-growing, which makes them ideal for testing a potting mix (Wander, 2015.) Comparing the germination and growth of a test crop in your home-made mix compared to a commercial blend will give you a good idea of the quality, assuming all factors are equal.

For a more scientific approach, you can purchase a pH and electrical conductivity (EC) meter to measure the chemical properties of your mix. Research has shown that nutrients are most available in a peat-based media when the pH is between 5.5 and 6.0 (Warncke and Krauskopf, 1983). EC is the measure of soluble salts, or fertilizer concentration, in the media. A Cornell study found that organic lettuce, spinach, and beet transplants grew best in a mix with an EC of 850 µS/cm, while mixes with EC of 1400 µS/cm had poor plant performance (Shaw et al., no date). In general, an EC of 260 to 750 µS/cm is good for germination and an EC of 760 to 1250 µS/cm is desirable for plant growth, as measured by 1:2 extraction method (one part soil to two parts water) (Shaw et al., no date). Some state Cooperative Extension Services offer potting mix analysis, which would be able to give you the pH, EC, and nutrient analysis of a mix. You can find a list of soil testing labs on the ATTRA website at https://attra.ncat.org/attra-pub/soil_testing/index.php. Just make sure that the lab is able to run a test specifically for potting mix, as a standard soil test will return inaccurate results. See the publication *Greenhouse Growth Media: Testing & Nutrition Guidelines* by Warncke and Krauskopf for a more detailed discussion of pH, EC, and nutrient levels in potting mixes.

Ingredients Allowed in Organic Potting Media

Even if you are making your own media, it is important to ensure that the individual ingredients are approved for organic production. Purchased components such as peat moss, perlite, and fertilizers may bear the OMRI or WSDA label, which would give you assurance that they are allowed. If you are unsure about a specific material, you can check the OMRI website or talk to your certifier.

Germinating seeds in a small batch of potting mix can serve as a quality test. Photo: Luke Freeman, University of Arkansas

Soil

The trend in containerized plant production has been towards soilless media to reduce the risk of plant disease and produce a consistent, uniform product. However, you will still find some organic growers who like to use soil in their potting mix. Soil will provide water and nutrient retention, will help the mix hold together for soil blocks, and will introduce beneficial microbes. The downside to using soil is that it can introduce soil-borne pathogens, weed seeds, and chemical contaminates into your mix, which can wreak havoc on your plant production. In addition, soil is relatively heavy and dense and can contribute to poor aeration and drainage in a mix, especially if small containers or plugs are used. Sterilization of soil in an oven or steamer can effectively eliminate pathogens, though it will also kill many of the beneficial microbes in the soil. More information on sterilizing soil can be found in the publication *How to Pasteurize Medium and Sterilize Containers and Tools* by Lamont, Kelley, and Sellmer, listed in the Further Resources section.

Regarding organic certification, clean commercial topsoil is an acceptable natural ingredient, but you have to be certain that it has not been treated with prohibited ingredients to kill microbes and weed seeds. Check the label or ask the supplier to be sure. If you are using soil from a farm or garden, use only the best and ensure that the soil is not from an area that has been treated with pesticides or has been subject to contamination. Some certifiers might even require that soil used must come from land in certified organic production.

Sand

Like soil, sand is a potting mix ingredient found in traditional recipes but used less commonly today. Traditionally, coarse builder's sand was used to add porosity to a mix, but perlite or vermiculite have replaced sand in modern mixes because of their sterile nature. If using sand in a potting mix, make sure that it is clean and free of contaminants. It is possible for sand to contain synthetic contaminants like herbicide residue that are prohibited in organic production. Two instances where sand may be necessary are in a blocking mix that benefits from the added weight and stability of coarse sand or in a mix for large potted plants where the added weight would keep the pots from tipping over.

Compost

Compost is a foundational ingredient in many organic potting mixes. High-quality compost will inoculate your potting mix with a diversity of beneficial microbes with a much lower risk of introducing pathogens and weed seeds than un-sterilized field soil. In fact, high-quality compost can actually suppress seedling diseases such as damping off and root rot by overwhelming the rhizosphere with beneficial microorganisms (Klein and Hammer, 2006; Wallace, 2012). Compost often contains enough nitrogen, phosphorus, and potassium to meet a seedling's nutritional needs for the first two to three weeks of growth (Rynk, 1992). Additionally, the presence of beneficial bacterial and fungi in the potting mix will assist in the mineralization (or break-down) of organic fertilizers into plant-available forms.

High-quality compost will improve the performance of an organic potting mix. Photo: NCAT

Joey Klein and Karl Hammer of Vermont Compost Company advise that careful watering and soil-temperature management are crucial to success with compost-based potting media (2006). Compared to peat-based growing mixes, compost-based mixes require less-frequent watering, which may be an adjustment if you are used to peat-based media. You should wait until the surface of compost-based media is dry before plants are watered again. Additionally, nutrient release from a compost-based mix is driven by temperature, so keeping the medium warm is critical to ensuring that plants are able to access the nutrients they need. Some growers will place transplants directly on a heated concrete slab or provide forced-air heating under the growing benches to keep the root zone above 60°F. Heating the irrigation water so that it is above 60°F will also help to keep soil temperature warm.

Some organic growers raise seedlings in 100% compost, but generally it is recommended to add compost to a potting mix at a concentration of 20 to 33% by volume (Rynk, 1992). Research on melon seedlings has indicated that a concentration of as much as 50% is beneficial (Tittarelli et al., 2009). Compost used in a potting mix should be high-quality, mature, and—ideally—screened to remove large particles. Unfinished compost or too much compost in a potting mix can actually inhibit seed germination and be detrimental to plant growth. Immature compost will produce ammonia gas, which damages seedlings (Grubinger, 2012). In addition, it is important to ensure that the compost used meets the NOP requirements for finished compost if manure was used as a feedstock. See the sidebar for more information on the NOP compost rule.

High-quality compost can be made at home or on the farm, though consistency in the final product can be difficult to maintain, due to the many variables involved. Many organic growers choose to purchase compost from a professional supplier to ensure that they have access to a consistent and high-quality product. If you are producing your own compost to use in a potting mix, test your compost by sending samples to a lab or conducting a germination test to ensure that it is fully mature before using it in a batch of potting mix. John Biernbaum from Michigan State University has developed a plant-based compost recipe that is used on the MSU student organic farm to produce a consistent and high-quality compost for use in their potting mix and in their vegetable beds. Plant-based composts such as this one generally have a lower EC, or salt content, than composts made with animal manures.

NOP Compost and Manure Rules

The National Organic Standards include rules for making compost and recordkeeping requirements for growers using compost in their production system (§205.2 of the NOP Final Rule). Compost-production records should include a list of feedstock materials, temperature logs, and records of management practices such as turning. In a static or enclosed-vessel composting system, compost piles must maintain a temperature between 131 and 170°F for at least three days; in a windrow system, the pile must reach these temperatures for at least 15 days and be turned at least five times. For vermicompost, production records must also be kept, but the temperature requirement does not apply (NOP 5021). More information can be found in ATTRA's *Tipsheet: Compost*.

Manure that has not been composted according to NOP guidelines has a restricted application window on edible crops due to food-safety concerns (§205.203(1) of the NOP Final Rule). For crops that have an edible portion that has direct contact with the soil, manure must be applied at least 120 days before harvest of that crop. For crops that have an edible portion that does not come in contact with the soil, manure must be applied at least 90 days before harvest of that crop. This restriction eliminates the option of using uncomposted manure in the growing media of greenhouse crops such as salad greens and baby vegetables that have less than 90 days to maturity. See ATTRA's *Tipsheet: Manure in Organic Production Systems* for more information.

Vermicompost will impart disease-suppressive qualities to a potting mix in addition to improving moisture retention and providing nutrients. Photo: Luke Freeman, Kerr Center for Sustainable Agriculture

Vermicompost

Vermicompost (or worm compost) will play a similar role to thermophilic compost in a potting mix, though less is generally needed, due to a higher concentration of nutrients and beneficial microbes. Unlike compost, vermicompost does not go through a thermophilic (or hot) stage and relies on the processing of worms, usually red wigglers *(Eisenia fetida),* to produce a finished and stable product. In a potting mix, vermicompost improves moisture retention and contains nutrients such as N, P, K, Ca, and Mg in readily available forms, with concentrations of nitrate-N that can be twice as high as those in themophilic compost (Leonard and Rangarajan, 2007; Wallace, 2012). Studies have shown vermicompost to improve seed germination and enhance rates of seedling growth and development due to plant growth hormones and humic acids (Edwards and Arancon, 2006).

Plant-based Compost Recipe by John Biernbaum

This recipe will make a compost that is relatively low in soluble salts and suitable for use in a potting mix. Adapted from *Greenhouse Organic Transplant Production* (Biernbaum, 2006).

- 1 bale straw
- 1 bale grass hay or grass-alfalfa mix
- 1 bale wood shavings for bedding
- 1 bale (3.8 cubic feet) peat moss
- 6 cubic feet (wheelbarrow) of soil
- 6 cubic feet (wheelbarrow) of grass clippings (or alfalfa hay)
- 6 to 12 cubic feet of green plants like comfrey, weeds without seed, green-manure cover crop, etc.
- Mineral organic fertilizers such as rock phosphate and greensand can be added

Biernbaum uses a manure spreader to mix and pile the ingredients, adding water during the mixing process. The pile heats rapidly and can maintain temperatures over 130°F for more than a week. For more rapid decomposition, alfalfa meal can be added at a rate of 25 pounds per 4 cubic yards, after first temperature decline. If made in the spring or summer and kept moist through the fall, this compost should be ready for use in a potting mix at the beginning of the next growing season.

Vermicompost has even greater disease-suppressive qualities than thermophilic compost and has been well-documented to suppress *Pythium* damping off of vegetable seedlings. Including vermicompost in a potting mix or applying a vermicompost liquid extract were both shown to be effective means of suppressing damping off of seedlings in research conducted at Cornell University (Jack and Nelson, 2010). A non-aerated vermicompost extract can be produced by mixing vermicompost with water at a ratio of 1:60 in a large container, with water circulated or mixed twice a day. Such a liquid extract can serve as a liquid fertilizer to provide P, K, and micronutrients, in addition to providing disease control.

Although vermicompost has a higher N content than thermophilic compost, additional fertilizers are often needed to meet the full nutrient requirements of transplants. Researchers at Cornell have found that the addition of a fertility mix of blood meal, green sand, and rock phosphate (at 7 pounds per cubic yard) to a peat-based mix containing 10% vermicompost can provide enough fertility to grow high-quality tomato and cabbage transplants without supplemental fertilizer (Leonard and Rangarajan, 2007; Rangarajan et al., 2008). Tomato and cabbage transplants grew nearly twice as large in potting mixes that contained 10% vermicompost plus the fertility mix, compared to potting mixes that just contained 10% vermicompost without the fertility mix. For more information on vermicompost, see ATTRA's *Vermicomposting: The Basics.*

Leaf Mold

Leaf mold is an ingredient found in many older organic potting mix recipes in lieu of peat moss. It is made from composted leaves and will provide structure and water-holding capacity to a potting mix, along with adding beneficial microbes. Unlike compost, leaf mold does not provide a significant source of fertility in the potting mix because it is made primarily from carbon-rich materials. The process of creating leaf mold takes six to 12 months, though it can be sped up with the addition of nitrogen fertilizer. The quality of the leaf mold will depend on the source of the leaves and length of the composting process. Some leaves, such as beech and eucalyptus, can contain germination-inhibiting substances, so it is recommended to run a germination test on a small batch of leaf mold before using it in a large quantity of potting mix (Bubel, 1998).

Sphagnum peat moss is a common component of organic potting media. Photo: Luke Freeman, NCAT

Peat Moss

Sphagnum peat moss is the most common component of soilless potting media because of its widespread availability, low cost, and ideal physical and chemical properties. Peat moss is a very stable organic material that provides structure and pore space to a potting mix while being resistant to decomposition. Sphagnum peat moss is acidic, with a pH of 3.5 to 4.0, so lime (calcitic or dolomitic) must be added to neutralize its acidity. Grubinger recommends the addition of lime at 8.5 pounds per cubic yard of peat and prefers dolomitic limestone because it supplies magnesium as well as calcium (2012). Sphagnum peat moss can hold 15 to 30 times its weight in water and will increase the cation exchange capacity (CEC) of a potting mix, which assists in nutrient retention.

Organic growers should be aware that many bagged peat products contain synthetic wetting agents that are not allowed in organic production. Look for the OMRI label or check with the manufacturer to ensure that the peat moss you are purchasing does not include synthetic additives. Organic wetting agents such as those made from yucca extract can be used and may be found in organic peat products. Most peat manufacturers now carry an organic line, so finding an organic-compliant product should not be difficult. Refer to Appendix 1 for a list of organic suppliers.

Sphagnum peat moss is the type most commonly used for horticultural purposes in North America, with most of the production occurring in Canada. However, other forms of peat are available and may be used in potting media. Light, dark, and black peats are mentioned in potting mix recipes and typically describe the same substance in various stages of decomposition, with darker peats being more advanced in decomposition than lighter ones. Also, the original vegetation of the peat makes a difference. Sphagnum peat moss is derived from peat bogs composed of sphagnum mosses, which are common in Canada. Sphagnum peat is lighter in color and less decomposed than other peats. Reed-sedge peat makes up the majority of U.S. peat production and is formed primarily from reeds, sedges, marsh grasses, cattails, and other wetland plants. Peat humus is usually derived from reed-sedge or hypnum moss peat and is in a more advanced stage of decomposition, typically dark brown or black in color (Byczynski, 2003).

The Sustainability of Peat Harvesting

Some growers question the sustainability of relying on peat in organic farming systems. Peat bogs, which are drained and mined during peat harvest, provide many environmental services and sequester 455 billion tons of carbon worldwide according to a report in the *New Scientist* (Sadowski, 2001). In addition, the rate of re-growth of peat deposits after harvest is incredibly slow, with peat in Canadian peatlands forming at 0.5 to 1.0 mm per year. Because of the long history of using peat as a fuel source in Europe, much of its peatland has already been exploited and destroyed, which has led to successful anti-peat campaigns in the U.K. and continental Europe (Grohmann, 2002).

In North America, however, the status of the peat supply is a different story. Most of the sphagnum peat moss used in North America is harvested in Canada where peatlands cover approximately 281 million acres. Of these natural peatlands, only 0.03%, or 73,500 acres, have been or are currently being harvested (CSPMA, 2015). Due to the abundance of supply, the regrowth rates far outpace rates of harvest, with more than 70 million metric tons of peat accumulating naturally each year, while current harvesting takes only one million tons (Byczynski, 2003). In a 2001 report, the North American Wetland Conservation Council concluded that Canadian peat-moss harvesting was not contributing to a significant decline in peatland functions or values on a national scale, that site management issues were being successfully addressed, and that there was room for further growth of the industry in a way that balances environmental interests with sustainable development (Daigle and Gautreau-Daigle, 2001).

Coir

An alternative to peat, coir originates from coconut husks and is a by-product of the coconut-fiber industry. The physical properties of coir are similar to sphagnum peat moss, but it is more granular in texture and has a higher pH that ranges from 4.8 to 6.8, depending on the source (Meerow, 1994). Coir also has elevated levels of phosphorus, potassium, sodium, and chlorine, which can give it a higher EC than peat (Carlile et al., 2015). It is usually shipped in compressed bricks that expand when wetted, holding up to nine times its weight in water (Grubinger, 2012). Coir is not as hydrophobic as peat and is easier to wet; however, it does tend to dry out more rapidly, meaning that irrigation practices would need to be modified if going from a peat-based media to a coir-based growing media (Abad et al., 2005).

Some consider coir to be more environmentally sustainable than peat because it is a by-product of industry rather than a product that is mined from a natural ecosystem. However, one must consider that coir travels much farther in shipping, originating from India, Sri Lanka, the Philippines, Indonesia, the Ivory Coast, and Central America. Because of the different areas of origin, the quality and attributes of coir can vary drastically depending on its source, with coir from Sri Lanka considered to be the highest quality and consistency (Abad et al., 2005). Some coir is processed with salt water, and this should be avoided due to high salinity.

Coir can be used to replace peat completely or partially in a potting mix recipe, though the nutrient and lime levels may need to be adjusted. A greenhouse study by Stamps and Evans (1997) found that potted *Dieffenbachia*, or Dumb Cane, foliage plants produced slightly more leaf mass when grown in coir-based media compared to peat-based media. Compared to the peat-based media, the coir-based media had elevated EC and potassium levels initially, which may have helped with early growth of the *Dieffenbachia*. A Florida study of tomato transplant production found that media containing more than 50% coir resulted in reduced transplant growth and vigor, likely caused by N immobilization by microbes with the higher C:N ratio of coir (Arenas et al., 2002). However tomato yields were similar in coir-based media compared to peat-based media.

Coir can be used to replace peat completely or partially in a potting mix recipe, though the nutrient and lime levels may need to be adjusted.

Composted Pine Bark

Composted pine bark will lighten a potting mix, increase pore space, and improve drainage, making it well-suited for perennial plants and nursery crops in larger containers. It is the primary component of most outdoor-container nursery mixes at 80 to 100% by volume (Robbins and Evans, no date). For vegetable-transplant production, however, composted pine bark is not recommended because it can tie up available N, requiring additional fertilizer to meet plant requirements (Biernbaum, 2006). A composting or aging process is required to eliminate phytotoxic compounds in the bark and make the material more resistant to decay. Other tree barks can be used, though pine is most common due to availability and cost (Will and Faust, 2010). Composted pine bark has a pH of 5.0 to 6.4, is low in soluble salts, and can impart disease resistance to containerized plants (Ferry et al., 1998).

Perlite

Perlite is made from crushed volcanic rock that has been rapidly heated and expanded to create a lightweight aggregate with high pore space. Because perlite does not absorb or hold water, it is used to reduce the weight of a potting mix, improve aeration, and increase drainage (Grubinger, 2012). Perlite is relatively inert, with a neutral pH, low CEC, and practically no nutrient value. However, it is a component of most potting mixes, making up as much as 50% of a mix. Perlite dust can pose a health risk if inhaled, so dust masks should be worn when handling the material.

Perlite is an organic potting mix component that adds pore space and improves drainage. Photo: Luke Freeman, NCAT

Vermiculite

Vermiculite is a silicate material that is also expanded by heating. Unlike perlite, the structure of vermiculite gives it the ability to retain water and nutrients, so it will improve water-holding capacity and CEC of a potting mix in addition to reducing bulk density. The pH of vermiculite ranges from neutral to slightly alkaline, and it will provide some Ca, Mg, and K to a mix (Will and Faust, 2010). Vermiculite comes in four size grades, with #1 being the coarsest and #4 being the finest. Fine vermiculite can be used as a medium for seed germination or to cover seedling flats to assist in germination and moisture retention. Coarser grades of vermiculite are ideal for a growing mix but should be handled with care, especially when wet, to avoid compacting the material (Robbins and Evans, no date). As with perlite, it is best to wear a dust mask when handling vermiculite, to avoid breathing in fine particles.

Limestone

Limestone, or lime, is added to a potting mix to increase the pH and neutralize acidic ingredients like peat moss. Calcitic and dolomitic lime are both natural materials and can be used in organic potting mixes. Calcitic limestone, or calcium carbonate ($CaCO_3$), is the most widely used form of agricultural lime and will provide calcium in addition to adjusting the pH. Some growers prefer dolomitic limestone, or calcium magnesium carbonate ($CaMg(CO_3)_2$), because it will also provide the nutrient magnesium (Grubinger, 2012). Finely ground limestone will be the fastest-acting, but it will still take a minimum of two weeks for the lime to fully react with the potting mix. Because of this, it is recommended to mix the lime with the other ingredients, moisten, and allow to sit for two weeks before using (Warncke and Krauskopf, 1983). Other products, such as burned lime (CaO) and slaked lime ($CaOH$), are not allowed in organic production.

Biological Inoculants

Although compost and vermicompost will add a slew of beneficial microbes to your potting mix, there are also specific organisms that can be added in the form of commercial inoculants. Arbuscular mycorrhizal fungi (AMF) are a class of fungi that will form symbiotic relationships with most crop plants and effectively increase their functional root system. AMF have been demonstrated to improve water and phosphorus uptake significantly, with N, Zn, Cu, and K uptake also improved to a lesser extent (George, 2000). Plants in the Brassica family do not form mycorrhizal associations, but for most other crops, adding an AMF inoculant to the potting mix will have a significant impact on plant performance. One study by David Douds at the Rodale Institute found that peppers inoculated with AMF were 34% larger than the control (Phillips, 2017). A German study showed that AMF can increase the number of buds and flowers set on geranium transplants and increase the P and K concentrations in the shoots (Perner et al., 2007). In addition to adding AMF inoculant in the potting mix, watering seedlings with seaweed extract has been shown to encourage the fungal association (Phillips, 2017).

Inoculants that contain beneficial fungi in the genus *Trichoderma* have been well-documented to improve the disease resistance and growth of transplants in the greenhouse, as well as plants in the field. Trichoderma fungi will colonize plant roots and defend them from pathogens by directly attacking and parasitizing fungal pathogens (Harman, no date). Inoculating a potting mix with Trichoderma species has been shown to impart disease resistance to transplants after they are planted in the field, in addition to improving root growth, imparting drought tolerance, and even reducing fertilizer need (Harman, no date). In a Colorado study, *T. harzianum* was shown to speed the germination of pepper seed and increase dry weight of tomatoes, peppers, and cucumber (Chang et al., 1986). Several commercial Trichoderma inoculants are available on the market, including RootShield® Plus, which contains *T. harzianum* and *T. virens* to control soilborne diseases such as *Phytophtora, Rhizoctonia, Fusarium,* and *Pythium*. Granular formulation can be mixed into the potting media, or a wettable powder can be applied as a drench.

Another class of biological inoculants includes rhizobacteria, which are bacteria that form an association with plant roots. These bacteria have also been shown to have beneficial effects on transplant growth and health when added to the potting mix. A Florida study found that rhizobacteria treatments, which included *Bacillus subtilis* and *B. pumilis,* added to tomato and pepper transplant media led to increases in transplant growth and improved survival and vigor once the plants were transplanted into the field, with yield improvements in some cases (Kokalis-Burelle et al., 2002). In other studies, inoculants that included *B. subtilis* and *B. amyloliquefaciens* increased the growth of tomato, cucumber, and pepper transplants, and provided protection against bacterial spot and late blight of tomato, and angular leaf spot and anthracnose of cucumber (Zehnder et al., 2001). Many commercial inoculants can be found that include several species of beneficial rhizobacteria. A list of inoculant suppliers is included in Appendix 1.

Biochar

Biochar is a less-common potting mix ingredient, but interest in the amendment is increasing and research has shown benefits of biochar in a potting mix. Biochar is essentially charcoal that is used for agricultural production and made from high-carbon feedstocks such as woody material. Because it is high in carbon and resistant to decay for hundreds or thousands of years, biochar is touted as a solution to sequestering atmospheric carbon in the soil (Glaser et al., 2002). More information can be found in the ATTRA publication *Biochar and Sustainable Agriculture.*

As a natural material, biochar is allowed in organic production and has been studied extensively as an amendment in field production, especially in highly weathered soils of the tropics. Research is also beginning to show the benefits of including biochar in potting media because of its physical and chemical properties. Biochar

Biochar can increase the pore space, water-holding capacity, and nutrient retention in a potting mix, as well as increasing the abundance of beneficial microorganisms. Photo: Luke Freeman, Kerr Center for Sustainable Agriculture

is incredibly porous with a high CEC, meaning that it can increase the air space, water retention, and nutrient retention in a potting mix. Research conducted at Iowa State University indicates that screened biochar can be used successfully to replace perlite in greenhouse potting media. The high pH of biochar can also neutralize the acidity of peat and eliminate the need for lime. A mix with 30% biochar and 70% peat moss had a pH and physical characteristics very similar to a commercial peat-perlite potting mix (Northup, 2013).

In addition to imparting physical properties to a potting mix, biochar has been shown to augment the biology of growing media to increase the population of beneficial microbes, which can lead to improved plant growth and yield. In a greenhouse study in Israel, fine biochar added to a coconut-fiber media at 1% to 5% resulted in increased growth and production for peppers and increased growth for tomatoes (Graber et al., 2010). In addition, peppers and tomatoes grown in biochar-amended media exhibited systemic resistance to gray mold and powdery mildew (Elad et al., 2010). The researchers found a greater abundance of beneficial microbes, including *Trichoderma*, rhizobacteria, and actinomycetes, in the media amended with biochar, indicating that the biochar had stimulated shifts in microbial populations towards beneficial plant-growth-promoting rhizobacteria and fungi. Either the shift in the microbial community or low doses of chemicals from the biochar may have been the cause of the increased plant growth and systemic resistance.

The presence of silica in potting media has been shown to improve the rooting of transplants, reduce wilting, and improve quality. Photo: Luke Freeman, NCAT

As a material with a high CEC, biochar also helps to retain nutrients in a potting medium. A USDA-ARS study in Ohio found that biochar added to a peat-perlite potting mix delayed nutrient release after liquid fertilizer application (Altland and Locke, 2012). At 5 and 10% concentrations of biochar, researchers found a delayed release of both nitrate and phosphate after fertilization and an increased release of potassium. This points to the ability of biochar to help mediate and prolong the availability of plant nutrients such as N and P, while adding significant amounts of K to a potting mix.

Although there are studies showing clear benefits of biochar in potting media, for some crops a high concentration of biochar can have detrimental effects. For example, a greenhouse study in Quebec that amended potting media with 50% biochar showed a negative effect on the growth of basil and lettuce, while the growth of coriander improved (Gravel et al., 2013). This points to a limit in the amount of biochar that should be added to a potting mix and shows that different crop species will be affected differently by the concentration. If experimenting with adding biochar to a potting mix, it is important to start with low concentrations (around 5%) and test small batches before using biochar on a large scale in your operation. In addition, biochar production in the United States is limited, so finding a commercial source for large quantities may be difficult.

Current research indicates that the benefits provided by biochar are greatly improved by composting the biochar before application. The composting process results in a carbon-coating of the biochar surfaces, which improves moisture retention and nutrient release (Hagemann et al., 2017), in addition to inoculating the biochar with beneficial microbes from the compost.

Silica

Silica (Si) is one of the most abundant elements on earth, found in nearly all mineral soils, but potentially absent from soilless potting media. Because of its abundance in natural systems, silica is often overlooked in conventional plant nutrition, even though its role in plant growth and pest resistance has been clearly established and it is a common ingredient in Biodynamic preparations. The benefits of adding silica to a soilless potting media that is otherwise deficient in Si are becoming quite clear through modern research. Oklahoma State University researchers found that silica fertilizers added to a peat-perlite substrate, applied as a drench, or applied as a foliar fertilizer showed benefits in potted sunflowers by increasing height, stem diameter, and flower diameter, improving the overall quality of the sunflowers (Kamenidou et al., 2008). The potting-media industry has caught on to the benefits of silica and has developed potting mixes enriched with silicon, claiming that their Si-enriched mixes will produce plants with more extensive rooting, less wilting, thicker stems, and earlier flowering (Rippy, 2015).

In an organic potting mix, silica may already be present if compost, soil, or sand are ingredients. Compost will vary in Si concentration depending on the source ingredients. For soilless potting mixes that are low in Si, organic formulations of silicon dioxide or rice husk ash can be used as a source of silica. Kamenidou et al. found that a concentration of 100 grams of Si per cubic meter of soilless media was ideal when rice husk ash was used (2008). Too much silica has been shown to have detrimental effects on plant growth, so test the addition of silica in small batches before using it across all of your greenhouse production.

Organic Fertilizers

Although many of the commercial organic mixes include a starter organic fertilizer, that fertilizer "charge" is not usually adequate enough to last the full length of time a transplant will be in the greenhouse. Most of these mixes are designed for the user to supplement fertility with liquid fertilizer applied through the irrigation water, starting three weeks after germination. You may find it beneficial to add a supplemental fertilizer blend to a commercial mix to provide for more of the plant's nutrient requirements from the soil. One important consideration is that a high fertilizer concentration can inhibit seed germination, so it may be best to start your seeds in a low-fertility mix and then pot-up into a "boosted" growing mix.

There are many organic fertilizers that can be added to a potting mix, and you will find a list of common organic fertilizers in Table 2. Organic fertilizers differ in nutrient content and how quickly those nutrients will become available to plants, because biological activity is required to mineralize (or break down) the organic nutrients into forms that plants can take up. Research at Cornell found that blood meal was a much more effective fertilizer source when compost or vermicompost were also included in a peat-based potting mix. Tomato transplants that were fertilized with blood meal were drastically larger when grown in media that also contained 20% compost or vermicompost (Leonard and Rangarajan, 2007). Measurements showed a peak in biological activity and nutrient release three weeks after planting.

Organic fertilizers such as bloodmeal, greensand, and soft rock phosphate are commonly used to increase the nutrient content of an organic potting mix. Photo: Luke Freeman, NCAT

As mentioned earlier, you may consider mixing fertilizer with your potting media ahead of time and allowing for an incubation period. This allows the biology in the potting media to begin to process the added organic fertilizers. Research on an alfalfa-based fertilizer (3-3-3) added to potting media indicated that a one- to three-week incubation period was optimal at application rates of 0.6% to 1.2% by weight (Nair et al., 2011).

The optimum application rate of fertilizer in a potting mix will depend on the fertilizer used and its nutrient value. Research at Cornell University found that the optimal addition of the organic fertilizer Sustane 8-4-4 to a Sunshine Natural & Organic #4 mix was five pounds per cubic yard for peppers and 10 pounds per cubic yard for tomatoes (Mattson and Beeks, no date). A fertilizer with a lower analysis would needed to be added at a higher rate and vice versa. You will find some organic fertilizer blends included in recipes for organic potting mixes in Appendix 2.

Table 2. A Selection of Organic Fertilizers for Use in Growing Media[a]

Fertilizer Material	Fertilizer Analysis			Rate of Nutrient Release	Comments
	%N	%P_2O_5	%K_2O		
Alfalfa Meal	2-3	1-2	2	Slow	Source of micronutrients
Bat Guano**	0-8	0-10	0-1	Medium to fast	Analysis varies greatly depending on source
Blood Meal	12	0-2	0-1	Medium to fast	
Bone Meal	2-4	14-16	0	Slow to medium	Source of Ca (20-24%)
Cottonseed Meal*	4-6	2-3	1	Slow to medium	Acidic
Crab Shell Meal	4	3-4	0	Slow	Source of Ca (14-18%) and chitin
Feather Meal	12-15	0	0	Slow	
Fish Emulsion (liquid)	2-5	3-4	1	Medium to fast	Liquid fertilizer, trace source of other macro- and micronutrients
Fish Meal	9-10	3-7	0-1	Medium	
Greensand	0	0	0-5	Very slow	Source of K, Mg, Fe, Si, and trace minerals
Kelp Meal	1	0-1	2	Slow	Source of micronutrients
Peruvian Seabird Guano**	12	10-12	2.5	Medium to fast	
Rock Dust	0	0	3-6	Very slow	Source of Ca, Si, and trace minerals
Rock Phosphate (Calphos)	0	3	0	Slow to medium***	Total 20% P2O5 with 20% Ca and trace minerals
Shrimp Meal	6	6	0	Slow	
Soybean Meal*	2	1	7	Slow to medium	
Sul-Po-Mag (Langbeinite)	0	0	22	Slow	22% sulfur, 11% magnesium

[a]Information compiled from various sources, including organic fertilizer suppliers (Peaceful Valley Farm Supply, Seven Springs Farm Supply, and Planet Natural) and Penhallegon, 2003.

**Cottonseed meal and soybean meal must be derived from non-GMO sources. Check with certifier to ensure product is compliant.*

***Some sources of guano are considered raw manure under the NOP and subject to application restriction. Check with certifier before using in a potting mix.*

****The availability of phosphorus in different forms of rock phosphate depends on the pH of the mix, biological activity, fineness of grind, and the chemical composition of the source rock. Precise performance is not easy to predict.*

Transplants grown in organic media will benefit from bottom heat to maintain the biological activity and nutrient cycling in the media. Photo: Luke Freeman, NCAT

Despite the addition of organic fertilizer to a potting mix, you may find that supplemental liquid fertilization is beneficial, as well. In a Canadian study on pepper transplants, optimal plant growth resulted from a mix of granular organic fertilizers (shrimp meal and kelp meal) mixed in the media, in addition to a liquid organic fertilizer (3-0.4-0.8) applied at watering three times per week (Gravel et al., 2012). Because of the biological process involved in mineralizing organic fertilizers for plant uptake, it is possible for plant uptake of nutrients to exceed the rate of release from biological mineralization – even if the nutrients are present in organic forms. It is important to monitor plant growth and be prepared to provide supplemental liquid fertilizer if it appears that growth is slowing.

Joey Klein and Karl Hammer, the founders of Vermont Compost Company, have found that soil temperature is critical for transplants to be able to access the nutrients they need from an organic compost-based media. Because nutrient release is biologically driven, this process will slow at cooler temperatures. They have found that it is helpful to provide heat directly to the potting media through a heated concrete slab or forced hot air delivered under the benches in a greenhouse. Also, warming irrigation water to 60°F with a hot water tank will help keep the potting media warm and active, resulting in more rapid transplant growth (Klein and Hammer, 2006).

Summary

There are many options for organic potting media. Whether you choose to purchase a pre-made commercial potting mix, work with a manufacturer to create your own custom blend, customize a commercial blend yourself with additional amendments, or make your own potting mix from scratch will depend on the specifics of your farming enterprise and the resources to which you have access. No matter where your potting mix comes from, it has an important job to do. A good-quality potting mix combined with the right environmental conditions will give your plants a strong start for success in the field or in containerized production.

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Substrates and Fertilizers for Organic Vegetable Transplant Production. Cornell Greenhouse Horticulture, Cornell University. www.greenhouse.cornell.edu/crops/organic.html

Appendix 1: Sources of Organic Potting Media and Approved Ingredients

Beautiful Land Products
360 Cookson Dr.
West Branch, IA 52358
Phone: 319-535-2570
Email: blp@beautifullandproducts.com
www.beautifullandproducts.com
Organic, compost-based potting mixes.

BioWorks, Inc.
100 Rawson Road, Suite 205
Victor, NY 14564
Phone: 800-877-9443
www.bioworksinc.com
RootShield® and other biological inoculants.

Bird Agronomics
12057 Mitchell Rd.
Bowling Green, OH 43402
Phone: 800-743-2473
www.birdagronomics.com
Biological inoculants including Trichoderma.

BuffaLoam, Inc.
20579 North County Road 103
Glendevey, CO 82063
Phone: 303-759-3303
www.buffaloam.com
OMRI-listed compost-based potting mixes.

CFS Specialties, Inc.
300 State Hwy 27
Cashton, WI 54619
Phone: 800-822-6671
Email: organic@cfspecial.com
www.cfspecial.com
Organic potting mix for soil blocks.

Coast of Maine, Inc.
145 Newbury St.
Portland, ME 04101
Phone: 800-345-9315
Email: sales@coastofmaine.com
www.coastofmaine.com
OMRI-listed compost-based potting mixes, mulches, and fertilizers.

Green Texan Organic Farms
1682 PR 3532
Quinlan, TX 75474
903-883-0430
www.greentexanfarms.com
OMRI-listed coir, vermicompost, and biochar.

Johnny's Selected Seeds
955 Benton Ave.
Winslow, ME 04901
Phone: 877-564-6697
Email: service@johnnyseeds.com
www.johnnyseeds.com
Organic potting mixes, amendments, and growing supplies.

Lambert Peat Moss, Inc.
106 chemin Lambert
Riviere-Ouelle, QB, Canada G0L 2C0
Phone: 800-463-4083
Email: info@lambertpeatmoss.com
www.lambertpeatmoss.com
OMRI-listed peat products and mixes.

Maestro-Gro
613 Colorado St.
Justin, TX 76247
Phone: 940-648-5400
Email: cbeckett@verizon.net
www.maestro-gro.com
Organic compost-based potting mixes and soil amendments.

Millenniumsoils Coir, a Division of Vgrove Inc.
111 Fourth Avenue, Suite 371,
St. Catharines, ON, Canada, L2S 3P5
Phone: 905-687-1877
Email: info@vgrove.com
www.vgrove.com
OMRI-listed coir media and mixes.

Ohio Earth Food, Inc.
5488 Swamp St., N.E.
Hartville, OH 44632
Phone: 330-877-9356
Email: info@ohioearthfood.com
www.ohioearthfood.com
Organic potting mixes and soil amendments.

Organic Mechanics Soil Company, LLC
P.O. Box 272
Modena, PA 19358
Phone: 610-380-4598
Email: mark@organicmechanicsoil.com
www.organicmechanicsoil.com
OMRI-listed, peat-free, compost-based potting mixes.

Peaceful Valley Farm & Garden Supply
P.O. Box 2209
Grass Valley, CA 95945
Phone: 888-784-1722
Email: helpdesk@groworganic.com
www.groworganic.com
Large selection of organic potting mixes, amendments, and growing supplies.

Premier Tech Horticulture
200 Kelly Rd. Unit E-1
Quakertown, PA 18951
Phone: 215-529-1290
Email: services@pthorticulture.com
www.pthorticulture.com
OMRI-listed peat-based mixes sold under the Pro-Mix label.

Seven Springs Farm Organic Farming and Gardening Supplies LLC
426 Jerry Lane
Check, VA 24072
Phone: 800-540-9181
Email: 7springs@swva.net
www.7springsfarm.com
Selection of organic potting mixes, amendments, and growing supplies.

Sun Go Horticulture
770 Silver Street
Agawam, MA 01001
Phone: 800-732-8667
Email: info@sungro.com
www.sungro.com
OMRI-listed peat products and mixes under Sunshine, Fefard, and Sun Gro labels.

Superior Peat Inc.
1700 Carmi Avenue
Penticton, BC, Canada V2A 8V5
Phone: 250-493-5410
Email: info@superiorpeat.com
www.superiorpeat.com
OMRI-listed peat products.

Vermont Compost Company
1996 Main St.
Montpelier VT 05602
Phone: 802-223-6049
Email:info@vermontcompost.com
www.vermontcompost.com
Organic compost-based potting mixes.

Appendix 2: Recipes for Growing Media

These recipes come from a variety of sources and present a wide range of options for working with organically acceptable materials. This list has been shortened from the previous version of the publication, with the following recipes selected for quality and the availability of ingredients.

Seed-Starting Mixes

Seedling Mix for Styrofoam Seedling Flats

Credited to the Farm and Garden Project at the University of California, Santa Cruz

- 2 parts compost
- 2 parts peat moss
- 1 part vermiculite, pre-wet

Sowing Mix

Credited to the Farm and Garden Project at the University of California, Santa Cruz

- 5 parts compost
- 4 parts soil
- 1 to 2 parts sand
- 1 to 2 parts leaf mold, if available
- 1 part peat moss, pre-wet and sifted

Note: All ingredients are sifted through a 1/4-inch screen. For every shovelful of peat, add two tablespoons of lime to offset the acidity.

Growing Mixes

NOFA-NY Classic Formula for Horticultural Potting Mix

Credited to the 1992 NOFA-NY Organic Farm Certification Standards

- 1/3 mature compost or leaf mold, sieved
- 1/3 fine garden loam
- 1/3 coarse sand (builder's sand)

NOFA-NY Sterile Peat-Lite Mix

- 1/2 cubic yards shredded sphagnum peat moss
- 1/2 cubic yards horticultural vermiculite
- 5 pounds dried blood (12% N)
- 10 pounds steamed bone meal
- 5 pounds ground limestone

Eliot Coleman's Organic Potting Mix

First published in the Winter 1994 issue of NOFA-NJ Organic News

- 1 part sphagnum peat
- 1 part peat humus (short fiber)
- 1 part compost
- 1 part sharp sand (builder's)

To every 80 quarts of this add:

- 1 cup greensand
- 1 cup colloidal phosphate
- 1 1/2 to 2 cups crab meal, or blood meal
- 1/2 cup lime

Soil Blocks

Several of the following recipes were designed for soil blocks. Soil blocks are created by pressing moist potting media into a form, which creates a block of soil for plant roots to grow in without the need for plastic containers. Eliot Coleman cites many advantages to using soil blocks in *The New Organic Grower,* including a reduction in plastic waste and benefits to root growth. Ladbroocke soil blockers are the most common tools for creating soil blocks and are offered by many online and mail-order garden supply companies. A soil-block mix needs to be able to hold its shape without crumbling and is usually slightly denser than a growing mix for containers. To this end, coarse sand is often used in place of perlite.

Soil blockers come in various sizes, which allow you to pot-up smaller seedling blocks into larger growing blocks. Photo: Luke Freeman, NCAT

Eliot Coleman's Blocking Mix Recipe

Adapted from the New Organic Grower, *1995*

- 3 buckets (standard 10-quart bucket) brown peat
- 1/2 cup lime (mix well)
- 2 buckets coarse sand or perlite
- 3 cups base fertilizer (blood meal, colloidal phosphate, and greensand mixed together in equal parts)
- 1 bucket soil
- 2 buckets compost

Mix all ingredients together thoroughly. Coleman does not sterilize potting soils; he believes that damp off and similar seedling problems are the result of overwatering, lack of air movement, not enough sun, over-fertilization, and other cultural mistakes.

Eliot Coleman's Blocking Mix Recipe for Larger Quantities

- 30 units brown peat
- 1/8 unit lime
- 20 units coarse sand or perlite
- 3/4 unit base fertilizer (blood meal, colloidal phosphate, and greensand mixed together in equal parts)
- 10 units soil
- 20 units compost

Eliot Coleman's Mini-Block Recipe

- 16 parts brown peat
- 1/4 part colloidal phosphate
- 1/4 part greensand
- 4 parts compost (well decomposed)

Note: If greensand is unavailable, leave it out. Do not substitute a dried seaweed product in this mix.

John Greenler's Seedling Mix for Soil Blocks or Seedling Flats

Credited to John Greenler, of Stoughton, Wisconsin, published in the January 1996 issue of Growing for Market.

- 2 3-gallon buckets sphagnum peat moss
- 1/4 cup lime
- 1 1/2 cups fertility mix
- 2 cups colloidal (rock) phosphate
- 2 cups greensand
- 2 cups blood meal
- 1/2 cup bone meal
- 1/4 cup kelp meal
- 1 1/2 buckets vermiculite
- 1 1/2 buckets compost

Directions for mixing:

1. Add peat to cement mixer or mixing barrel.
2. Spread the lime and fertility mix over the peat.
3. Mix these ingredients thoroughly.
4. Add the compost and vermiculite and mix well again. When done, examine the distribution of vermiculite to ensure that it has been mixed in evenly.

Note that all bulk ingredients should be screened through 1/4-inch hardware cloth. Well matured, manure-based compost should be used (avoid poultry manure and wood-chip bedding).

Vernon Grubinger's Typical Recipe for an Organically-Approved Potting Mix

From Sustainable Vegetable Production from Start-Up to Market *and adapted from recipes in* The Real Dirt: Farmers Tell about Organic and Low-Input Practices in the Northeast, *1994.*

- 5 gallons mature, screened compost
- 5-10 gallons peat moss
- 1-5 gallons vermiculite and/or perlite
- 1-2 cups lime (or 2% wet weight of peat)
- 1-2 cups bone meal (or colloidal rock phosphate)
- 1-2 cups blood meal
- 1-2 cups greensand or ¼ cup sul-po-mag

Jean-Martin Fortier's "All-Purpose" Mix

Adapted from The Market Gardener, *2014. Note that a bucket measures 4.2 gallons.*

- 3 buckets peat moss
- 2 buckets perlite
- 2 buckets compost
- 1 bucket garden soil*
- 1 cup blood meal**
- ½ cup agricultural limestone

*A light garden soil is recommended. Fortier prefers to use un-sterilized garden soil to introduce living organisms into the mix.

**Double the blood meal amount if using mix for potting-up seedlings. Feather meal can be substituted for blood meal.

Luna Circle Recipe

Credited to Tricia Bross of Luna Circle Farm in Gays Mills, Wisconsin, presented at MOSES Conference, 2001.

- 2 buckets black peat (1 bucket = 8 quarts)
- 1/2 bucket compost
- Fertility mixture:
  - 1 cup greensand
  - 1 cup rock phosphate
  - 1 cup kelp meal
- 2 buckets sphagnum peat moss
- 1 bucket sand
- 1 bucket vermiculite

Directions for mixing:

- Screen the peat and the compost and combine with the fertility mix.
- Mix well.
- Add the sphagnum, sand, and vermiculite.
- Mix well again.

Tipi Produce Recipe

Credited to Steve Pincus of Tipi Produce of Madison, Wisconsin, presented at MOSES Conference, 2001.

- 2 bales sphagnum peat moss (3.8 or 4.0-cubic-foot bales)
- 1 bag coarse vermiculite (4.0 cubic foot bags)
- 1 bag coarse perlite (4.0 cubic foot bags)
- 6 quarts of a fertilizing mixture comprised of:
  - – 15 parts steamed bone meal
  - – 10 parts kelp meal
  - – 10 parts blood meal
  - – 5 to 10 parts dolomitic limestone (80 to 90 mesh)

Note: This mix works well in small and medium plug trays and 1020 flats for growing lettuce, onions, leeks, peppers, tomatoes, melons, squash, cucumbers, and many flowers. When repotting small plugs into larger cells, add about 1/3 by volume of old leaf mold or compost and more fertilizing mixture. Continue to fertilize twice per week with soluble fish and seaweed fertilizer.

Vegetable Transplant Recipe

Adapted from On-Farm Composting Handbook, *by Robert Rynk, (ed.), 1992.*

Equal parts by volume of:

- compost
- peat moss
- perlite or vermiculite

Bedding Plant Recipe

Adapted from On-Farm Composting Handbook, *by Robert Rynk (ed.), 1992.*

- 25% compost
- 50% peat moss
- 25% perlite or vermiculite

Growing Mixes for Large Containers

Container Mix for Herbaceous and Woody Ornamentals

Adapted from On-Farm Composting Handbook, *by Robert Rynk (ed.), 1992.*

Equal parts by volume of:

- compost
- coarse sand
- peat moss or milled pine bark

Growing Mixes for Pots and Baskets

Published in the September 1990 issue of Greenhouse Manager *in an article entitled "Recipes for Success in Media Mixes," by Kathy Z. Peppler.*

- 30% topsoil
- 60% peat
- 10% perlite
- 5 pounds lime per cubic yard
- 3 pounds dolomitic lime per cubic yard

By George Kuepper, NCAT Agriculture Specialist,
And Kevin Everett, Program Intern

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By Luke Freeman, Sustainable Agriculture Specialist

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