Potting Mixes for Certified Organic Production
Horticulture Technical Note

George Kuepper
NCAT Agriculture Specialist
and Kevin Everett, Program Intern

Reviewed October 2010
IP112

Abstract

Organic production of seedlings, transplants, and potted plants requires the use of media that meet the requirements of the National Organic Standard. This publication lists commercial sources and provides formulas and guidance for on-farm preparation of approved media.

Table of Contents

Introduction

Farms and nurseries use various seedling and potting media in the production of field transplants, container plants, and greenhouse crops. Such media may contain a wide range of natural and synthetic materials. In certified organic production, there are limitations on the materials that may be used, either as base substrates or for supplemental fertilization. This publication will help organic producers find commercial sources of organic potting media — or make their own.

Commercial Blends

Organic producers who choose not to mix their own growing media either purchase pre-packaged mixes or arrange with manufacturers to have a mix custom-blended for them. The latter option is occasionally chosen by large growers and by groups of growers who pool their orders to save money. Some enterprising growers order more than they need and sell potting media as a sideline.

For those who buy off-the-shelf, finding appropriate growing media can be a challenge. Until recently, the market for organic seedling and potting media has been small, and few commercial blends have been readily available. Also, due to occasional changes in requirements of the national Organic Standard, acceptability of products may change somewhat over time. The Washington State Department of Agriculture's organic program also reviews and lists allowed products. Their product listing can be viewed on the Organic Food Program website.

One good indication that a commercial product is acceptable in organic production is a label stating that the product is "OMRI Listed." OMRI — the Organic Materials Review Institute (1) — is a nonprofit entity that evaluates products and processes for the organic industry. OMRI Listed products have been thoroughly reviewed and are consistent with the requirements of the National Organic Standard.

However, to be absolutely certain that a product is acceptable for organic use, read the label to learn the ingredients. If any components of the mix are questionable, check with your certification agent before buying it. This publication discusses many of the ingredients allowed in organic production, as well as those that are prohibited — or at least suspect.

To help you locate commercial sources of growing media and some of the main ingredients, there is a list of commercial sources in**Appendix 1**. This list was assembled in the spring of 2001 and updated in 2010. Since company ownership, media formulations, and available products can change with time, you should ask questions to make sure you are getting an organically approved product.

Making Your Own

All good potting media should meet the needs of plant roots for air, water, nutrients, and support. These needs will vary, however, depending on the plant and its stage of growth. The technical details are beyond the scope of this publication and can be found in standard horticultural literature and publications distributed by the Cooperative Extension Service. A list of several information resources about growing media is in **Appendix 2**. Some of these focus on organic systems; others address conventional production but contain basic and/or relevant information. Anyone who wants to produce consistent, high-quality growing media should study and do detailed research.

© 2004 www.clipart.com

Working from tried-and-true recipes is a good idea, especially at the beginning.**Appendix 3** features several recipes for organic media blends. Some of these recipes are found in published literature; others are from conference and workshop handouts or notes with uncertain authorship. Experimentation is the only sure way of knowing which blend or blends will work best for a particular farm or crop.

When experimenting, begin by making small batches and give them a thorough evaluation. The next step is largely logistical: assembling the components and equipment and finding space and labor for the mixing and storage. Storage can present its own challenges, especially preventing contamination by weed seeds.

Contrary to what some critics say, organic growers are permitted to use a wide array of materials in growing media. The challenge is more a matter of ensuring consistent quality of ingredients than in finding enough of them. The section that follows features a brief description of some of the materials commonly used in organic growing media and discusses some of the issues that surround them.

Ingredients Allowed in Organic Potting Media

Soil. For many years, the trend in conventional growing has been toward soilless media. A major reason for this is concern about soil-borne plant diseases and the excessive density of mixes where soil is a dominant ingredient. However, soil is still used in some organic blends.

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. Consider solarizing, steam pasteurization, or oven heating if the soil has any history of soil-borne diseases. Microwaving is effective for pasteurization, but some certifiers might not allow it. Soil contaminated with pesticides, prohibited fertilizers, or environmental pollutants may not be used. Certifiers might require that any soil used must come from land in certified organic production.

Sand. Sand in a growing mix can make a difference. Coarse sand — called builder's sand — is best. It adds air spaces to the potting mix. Avoid plaster sand and other fine sands. They tend to settle into the spaces between the other ingredients and make a dense mix. Clean, washed sand has a near-neutral pH and little if any food value for plants. Sand is much heavier than any other ingredient used in potting mixes. The added weight is good for tall, top-heavy plants that might blow or tip over, but it is not the best choice for plants that will be shipped or moved a lot. Sand is the least expensive and most readily available larger-particle material.

Compost. Compost is perhaps the most common potting-mix ingredient among organic producers. Cheaper than traditional components such as peat moss, compost holds water well, provides nutrients, and can be made right on the farm.
The quality of compost depends in part on how it is made, but especially on what it is made from. The variability of commercial compost is one of the main reasons it is less common in commercial organic media. Lack of availability is also a common problem.

Experienced compost makers know that compost quality is directly affected by the raw ingredients. If the feedstocks are low in nutrients, the resulting compost will also be nutrient-poor. To produce a high-quality, media-grade compost, it is a good idea to make it according to a recipe — using a specific blend of balanced ingredients — rather than simply using whatever feedstocks come to hand. The end product will be more consistent and better-suited for blending with peat and other components.

According to one source (2), premium compost for nursery mixes should have:

- pH of 6.5 to 8.0
- no (or only a trace of) sulfides
- <0.05 ppm (parts per million) ammonia
- 0.2 to 3.0 ppm ammonium
- <1 ppm nitrites
- <300 ppm nitrates
- <1% CO_2
- moisture content of 30 to 35%
- >25% organic matter
- <3 mmhos/cm soluble salts

Compost and Manure Rules

The National Organic Standard is very explicit about compost making (8). Compost piles must maintain a temperature between 131 and 170 degrees Fahrenheit for at least three days in a static or enclosed vessel system, or at least 15 days in a windrow system, with at least five turnings. Unless these criteria are met, the resulting product is not — in the eyes of the National Organic Program — considered compost. Rather, it is simply a pile of raw materials. If one of those raw materials is manure, it can make a big difference in how it may be used in crop production.

Raw livestock manure can carry pathogens that pose a danger to human health. The principal reason behind the NOP-approved process for composting is to prevent possible food contamination with these organisms. Maintaining high temperatures in the compost pile kills off most microorganisms that are pathogenic to humans, and the resulting material is believed safe to use on crops at any stage up through harvest.

Heat-treated, dried, and other processed manures, and manure that has not been composted according to NOP specifications, may still be used in organic crop production. However, it must be applied as if it were raw manure. According to the NOP's rules (9), raw manure:

- can be applied at will to crops not intended for human consumption
- cannot be applied to a crop within 120 days of harvest if the edible portion has direct soil contact
- cannot be applied to a crop within 90 days of harvest when the edible portion does not have soil contact

We believe that these restrictions will be strictly enforced. Among the growers most at risk of manure rule violations are those that use organic media for direct greenhouse production of salad greens, edible flowers, and baby vegetables, because the time from seeding to harvest is brief. This specialty market is a significant one for many organic producers, and serious errors can result in a loss of certification, bad publicity, and even endangerment of public health.

When making compost for media, plan at least six months in advance of when it will be needed. For spring transplants, compost should be made the previous summer and allowed to age through the fall and winter. Composting is not difficult, but it does require some experience and a variety of clean, organically acceptable components. Animal manures and bedding, farm and garden waste, grass and alfalfa hay, and other materials can be combined to make a high-quality, reasonably consistent compost. Organic amendments such as greensand and rock phosphate can be added during the composting process to increase nutrient content. Protein-rich sources such as alfalfa and seed meals can also be included, if additional nitrogen is needed. While most compost will provide adequate amounts of phosphate, potash, and the necessary micronutrients, nitrogen has proved to be the most variable element and the most important to manage.

Compost is rarely used alone as a potting medium. Most compost is too porous and the soluble salt levels are often high. Rynk (3) recommends 20 to 30% compost content in potting mixes. Growers may use up to 50% in mixes for larger vegetable transplants (4).

In many circumstances, compost can suppress plant disease. Israeli researchers discovered that vegetable and herb seedlings raised in a mix of 40% vermiculite, 30% peat moss, and 30% composted cow manure grew faster, with less incidence of disease, than those raised in a 40% vermiculite/60% peat moss mix (5). To understand how compost suppresses disease, it is helpful to know how plant substances are broken down during the composting process. Compost goes through three phases. During the first phase, temperatures rise to 104 to 122 degrees

Fahrenheit and materials that degrade easily are broken down. In the second phase, temperatures are between 104 and 149 degrees Fahrenheit, and substances like cellulose are destroyed. Also destroyed in this phase are plant pathogens and weed seeds, and (unfortunately) some beneficial biological- control organisms are also suppressed. The third stage is the curing phase, when temperatures begin to fall. It is during this phase that humus content increases and some beneficial organisms — like *Streptomyces, Gliocladium,* and *Trichoderma*, which serve as biocontrol agents — re-colonize the compost (6). This re-colonization is somewhat random. For example, composts produced in the open near a forest are more consistently suppressive than those produced in enclosed facilities. The reason appears to be the abundance of microbial species found in the natural environment (7). For more information on composting, ask for the *Farm-Scale Composting Resource List* [HTML].

Composted pine bark. Composted pine bark has a high lignin content, making it slow to degrade. Bark lightens the mix, increases air space, and decreases water-holding capacity. It may be substituted, in part, for peat moss. Rynk specifically recommends it as a component in blends for potted herbaceous and woody ornamentals (3). Composted pine bark appears to impart some disease resistance (10). Its pH is generally 5.0 to 6.5, and it is low in soluble salts. Mixes using composted pine bark will probably require more nitrogen supplementation.

Sphagnum peat moss and other forms of peat. Sphagnum peat moss is the most commonly used soilless medium, because it is widely available and relatively inexpensive. Peat moss is a very stable organic material that holds a great deal of water and air and does not decompose quickly. Peat moss is quite acidic (pH 3.5 to 4.0); limestone is commonly added to the mix to balance the pH. Younger, lighter-colored peat moss does a better job of providing air space than older, darker peat that has few large pores.

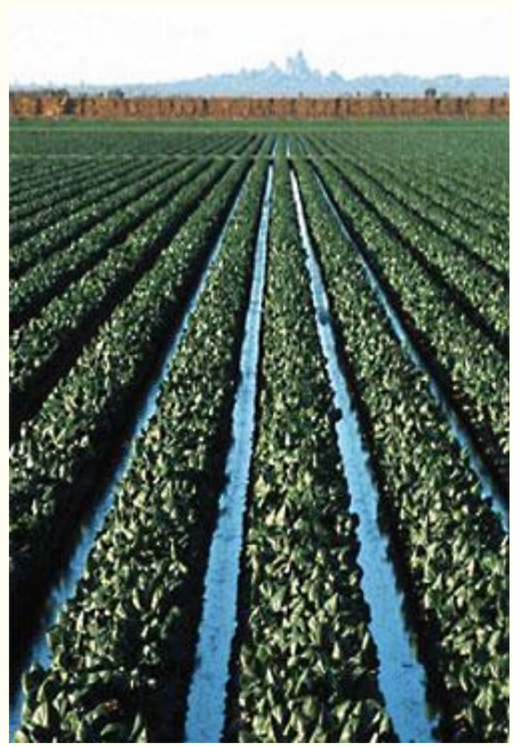

Photo by Jeff Vanuga © NRCS 2004

Organic growers should be cautious when purchasing peat moss. A few commercial sources may be treated with wetting agents. Since all but a very few of the commercial wetting agents are prohibited in organic production, assume that any product with an unspecified wetting agent is prohibited. A few suppliers of untreated peat moss are listed in **Appendix 2**.

Other forms of peat can be used in growing media, though not all are readily found in the marketplace. Sphagnum peat moss — discussed here — is the most common peat and represents its least-decomposed form. *Light*, *dark*, and *black* peats typically describe the same substance in various stages of decomposition; darker peats are more advanced in decomposition than lighter ones. There are also some differences in the original vegetation that decomposed to make the peat. Besides the peat formed by decomposed sphagnum moss, other peats come from reeds, sedges, and grasses. Reed sedge peat is typically very dark or black and does not have visible peat fibers. It is very difficult to rewet when dried and readily "fixes" phosphate. While the darker grades are more commonly used for amending horticultural soils, some potting blends still use them. Any type of peat will work in mixes, but expect different results with each. Blending of different types of peat is done quite often.

Growers may have concerns about the rare but serious disease called *Cutaneous sporotrichosis*. Also known as "sporo," this is a fungal infection that can be contracted through cuts and scratches in the skin while handling sphagnum moss — the living moss that grows on top of a sphagnum bog and is used in the floral industry to line wire baskets and make wreaths. Living sphagnum moss is removed prior to the harvest of the underlying sphagnum peat, which is dead material and no longer supports or harbors the fungus. There is no hazard of contracting *Cutaneous sporotrichosis* through the handling of sphagnum peat moss (11).

Coir. Coir dust, a mixture of short and powder fibers, is a by-product of the coconut fiber industry. Most coir comes from India, Sri Lanka, the Philippines, Indonesia, and Central America (16). It looks like sphagnum peat but is more granular and does not contain twigs or sticks (17). Coir has a pH of 5.5 to 6.8 and usually contains higher levels of potassium, sodium, and chlorine than peat (18). Coir lasts two to four times longer than peat, but it is more expensive, mainly because of shipping costs (18). Coir is typically shipped in compressed bricks, which expand when wetted. It is easier to wet than peat because there is no waxy cutin to repel water (17). It also has a greater water-holding capacity than peat.

In a study performed in the mid-1990s at Iowa State University, researchers found that petunias and marigolds planted in a mix of 80% coir and 20% perlite grew both taller and heavier (19).

One distributor recommends a mix of three parts coir to one part compost (8). Another offers a product that contains 35 to 45% coir blended with peat moss, vermiculite, and pine bark (18).

There are a few cautions when using coir. Supplemental fertilization with potassium may need to be cut back and nitrogen increased. There is also the possibility of salt damage (20). Salt water is customarily used in the processing of some coir fiber and it is important to purchase only low-salt coir products. It is also wise to ask whether any prohibited wetting agents or binders have been added to any commercial product. Some coir suppliers are listed in **Appendix 1**.

Newspaper. Ground-up newspapers can be used as a substitute for peat moss in growing media. Newsprint should not be more than 25% by volume of the mix. Avoid the inclusion of glossy paper or paper with colored inks, as these are prohibited.

Questions About Peat Harvesting

The journal *New Scientist* reports that 455 billion tons of carbon are sequestered in peat bogs worldwide. That is equivalent to about 70 years of industrial emissions, making conservation of peat bogs as important an issue as saving the rainforests (12). Much of the peatland in Europe has already been exploited and destroyed, in good part to provide fuel for power plants (13). Therefore, concerns about the sustainability of peat harvesting in North America are certainly justified.

The source of the harvested peat is the first factor in assessing the problem. Sphagnum peat moss appears to be the least threatened at the moment. Most sphagnum peat comes from 40,000 acres of bogs in Canada. These bogs are extensive, and less than 1% of the total is harvested annually. Within five years after a section is harvested, the peat moss is growing again, and the bog is restored to a functioning peatland (15). However, peat bogs grow at the rate of only one millimeter per year (13), and increased demand from Europe may encourage more extensive harvesting.

In the United States, 17 states produce peat, including Alaska, Florida, Michigan, and Minnesota. About 81% of U.S. production is reed-sedge peat (14), which is usually harvested from marshes, mountain fens, and other sensitive wetlands. The environmental impact and sustainability of reed-sedge peat harvesting as it is now practiced is certainly questionable (15).

Alfalfa. Alfalfa may be a good locally-available alternative to peat moss. Alfalfa provides nutrients — especially nitrogen — that are released slowly. Raw alfalfa must be processed before use in growing media. Dried alfalfa is ground and passed through a 2-cm screen. Water is added and the alfalfa is allowed to decompose for 20 days. It is then air-dried for another 20 days before use.

Kenaf. Kenaf (*Hibiscus cannabinus*) is a fibrous plant grown in warmer regions of the U.S. Portions of the plant are used to make paper, and the waste products can be used in growing media. Kenaf stalks contain two different fibers, bast and core. The core material is most suitable as a potting mix ingredient. Growers who have used kenaf have seen excellent results. Two greenhouse studies conducted in 1993 and 1995 showed that coarse-grade kenaf core in a 1:1 ratio with peat moss can be a suitable replacement for bark (21).

Kenaf (*Hibiscus cannabinus*) is a fibrous plant grown in warmer regions of the United States. Portions of the plant are used to make paper, and the waste products can be used in growing media.

Sawdust. The quality of sawdust used as media depends on the wood. Cedar, walnut, and redwood sawdust can be toxic to plants. Oak, hickory, and maple are reputed to tie up soil nitrogen more readily than sawdust from evergreens. Sawdust from treated or painted lumber is not allowed in organic production.

Clay. Several Canadian studies have shown that adding marine glacial clay (a non-swelling mica clay) to sawdust significantly increases the size of greenhouse-grown cucumbers and increases the size and flowering of impatiens and geraniums (22). The researchers tested up to 42.8 grams of clay per liter of sawdust. At North Carolina State, investigators also found that adding arcillite — a calcined montmorillonite and illite clay — to pine bark increased the growth of cotoneaster (23).

Perlite. Perlite is a volcanic rock that is heated and expanded to become a lightweight white material. It is sterile and pH-neutral. When added to a soil mix, perlite can increase air space and improve water drainage. It is a hard material that does not break apart easily. Perlite pieces create tiny air tunnels that allow water and air to flow freely to the roots. Perlite will hold from three to four times its weight in water, yet will not become soggy. It is much lighter than — and can be used instead of — sand.

Vermiculite. Vermiculite is a micaceous mineral that is expanded in a furnace, forming a lightweight aggregate. Handled gently, vermiculite provides plenty of air space in a mix. Handled roughly, vermiculite compacts and loses its ability to hold air. Vermiculite holds water and fertilizer in the potting mix. It also contains calcium and magnesium and has a near-neutral pH. Vermiculite comes in different grades. Medium grade is usually used for starting seeds. A coarse grade can be used in soil mix for older plants.***Limestone.*** Calcium carbonate ($CaCO_3$) and calcium magnesium carbonate (called dolomitic limestone) are natural forms of lime that are used to adjust pH and provide nutrients. Many other lime products — burned (CaO) and slaked limes (CaOH) — are prohibited. Lime should be well ground for use in growing media.

Alternative Fertilizers. Various organic fertilizers are often used in media. This is especially important in blends that contain little or no compost or soil, since the nutrient content of most other substrates is usually quite low. The base ingredients of the growing media may also influence the choice of fertilizers to be added. Fertilizers that are slowly available may be a poor choice in blends that lack the active microbial complex found in good compost or rich garden soil. Also, many organic fertilizers have a significant effect on pH, and adjustments may need to be made in that regard.

Vermiculite and Asbestos

During the summer of 2000, reports began to surface warning of asbestos contamination in vermiculite. Most of the nation's vermiculite originates from a mine near Libby, Montana, where the ore naturally contains about 2 to 3% asbestos fibers. Apparently, all sources of natural vermiculite contain some level of asbestos (24). The principal danger comes from inhaling the asbestos fibers, which are known carcinogens.

As of July 2001, there has been no action by the federal government to recall, regulate, or enforce safety labeling on vermiculite products. The Environmental Protection Agency, however, has advised commercial growers to find substitutes for vermiculite in potting media (25).

If vermiculite must be used, work with it only in well-ventilated areas, wet the material as soon as possible, and blend it with materials that help reduce dust levels. Wear a dust mask and gloves as added protection.

Asbestos contamination has not yet made vermiculite a prohibited substance in organic production, but that is a possibility in the future. Until that time, each producer should weigh the risks before using this material.

Table 1 features a number of the more common organic fertilizers that can be added to growing media. Several characteristics are noted for some of these products, where that information is known.

For more information on these fertilizers and other alternatives, ask for ATTRA's *Alternative Soil Amendments* [HTML] [PDF/811K]. To locate sources, see the *Sources of Organic Fertilizers and Amendments* [HTML] resource list.

Table 1. A Selection of Organic Fertilizers for Use in Growing Media[a]

Fertilizer Material	Estimated N-P-K	Rate of Nutrient Release	Salt and pH Effects
Alfalfa Meal	2.5 – 0.5 – 2.0	Slow	
Blood Meal	12.5 – 1.5 – 0.6	Medium-Fast	
Bone Meal	4.0 – 21.0 – 0.2	Slow	Tends to acidify
Cottonseed Meal[b]	7.0 – 2.5 – 1.5	Slow-Medium	
Crab Meal	10.0 – 0.3 – 0.1	Slow	
Feather Meal	15.0 – 0.0 – 0.0	Slow	
Fish Meal	10.0 – 5.0 – 0.0	Medium	
Granite Meal	0.0– 0.0 – 4.5	Very Slow	
Greensand	0.0– 1.5 – 5.0	Very Slow	
Bat Guano	5.5 – 8.6 – 1.5	Medium	
Seabird Guano	12.3 – 11.0 – 2.5	Medium	
Kelp Meal	1.0 – 0.5 – 8.0	Slow	Possibly high-salt
Dried Manure	Depends on source	Medium	Possibly high-salt
Colloidal Phosphate	0.0 – 16.0 – 0.0	Slow-Medium[c]	

Rock Phosphate	0.0 – 18.0 – 0.0	Very Slow-Slow[c]	
Soybean Meal	6.5 – 1.5 – 2.4	Slow-Medium	
Wood Ash	0.0 – 1.5 – 5.0	Fast	Very alkaline, salts
Worm Castings	1.5 – 2.5 –1.3	Medium	

(a) Information in the table has been adapted primarily from Penhallegon, Ross. 1992. Organic fertilizer NPK values compiled. In Good Tilth. January. p. 6.; *and* Rodale Staff. 1973. Organic Fertilizers: Which Ones and How To Use Them. Rodale Press, Emmaus, PA. p. 50.

(b) Cottonseed meal from many sources may be too contaminated by routine pesticide use to be permitted in certified production. Since most cotton is now genetically engineered with Bt genes, it may also be prohibited for this reason. Growers should consult their certifiers before using.

(c) 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.

Mad Cows and Potting Mixes
Bovine Spongiform Encephalopathy (BSE), or "Mad Cow Disease," is a fatal brain disorder that can infect humans, where it is recognized as Creutzfeldt-Jakob Disease (CJD) — a devastating illness. According to authorities, BSE is not a problem in the United States (26). However, the fear of BSE and CJD has prompted the Demeter Association — which certifies Biodynamic farms — to completely prohibit the use of bone meal and blood meal, since these could be avenues of infection for BSE (27). Blood meal, bone meal, and other animal by-products are permitted in certified organic production as soil amendments, though they cannot be fed to organic livestock. As a precaution, dust masks and gloves should be worn when handling these materials.

Summary

Conventional growing media that contain synthetic wetting agents and standard fertilizers cannot be used in organic production of field transplants, container plants, and greenhouse crops. Acceptable growing media can be compounded from a wide variety of approved materials. These organic blends may be purchased off-the-shelf, custom-blended by manufacturers, or produced on-farm.

References

1) The Organic Materials Review Institute (OMRI)
Box 11558
Eugene, OR 97440-3758
541-343-7600
541-343-8971 FAX
info@omri.org

2) Shirley, Christopher. 1995. Profit making compost. The New Farm. January. p. 20, 22–26, 47.

3) Rynk, Robert (ed.). 1992. On-Farm Composting Handbook. Publication NRAES-54. Northeast Regional Agricultural Engineering Service, Cornell Cooperative Extension, Ithaca, NY. p. 81.

4) Brown-Rosen, Emily. 2001. Organic Materials Review Institute. November. Personal communication.

5) Williams, Greg, and Pat Williams. 1998. Compost as a substitute for peat in seedling grow mix. HortIdeas. December. p. 137.

6) Rynk, Robert (ed.). 1992. On-Farm Composting Handbook. Publication NRAES-54. Northeast Regional Agricultural Engineering Service, Cornell Cooperative Extension, Ithaca, NY. p. 6–13.

7) Hoitink, H.A.J., Y. Inbar, and M.J. Boehm. 1991. Status of compost-amended potting mixes naturally suppressive to soilborne diseases of floricultural crops. Plant Disease. September. p. 869–873.

8) Terms Defined — Compost. §205.2 of the National Organic Program Final Rule.

9) Soil fertility and crop nutrient management practice standard. §205.203(1) of the National Organic Program Final Rule.

10) Ferry, Shannen, et al. 1998. Soilless media: practices make profit. Greenhouse Grower. July. p. 28, 33–34, 36.

11) Relf, Diane. 1996. Sphagnum moss vs sphagnum peat moss. Virginia Cooperative Extension, Blacksburg, VA. August.

12) Sadowski, I.E. 2001. Doing the peat bog two-step. Mother Earth News. June–July. p. 18.

13) Grohmann, Sissi. 2002. Peat bogs: preservation or peril? Permaculture Activist. May. p. 23–27.

14) Byczynski, Lynn. 2003. Should you use peat in the greenhouse. Growing For Market. January. p. 11–12.

15) Fowler, Veronica. 1999. Peat harvesting: sustainable or not? National Gardening. March–April. p. 28.

16) Nelson, Josh. 1998. Coconuts to the rescue. Organic Farms, Folks & Foods (Published by NOFA-NY). July–August. p. 8–9.

17) Hulme, Fred, Rick Vulgamott, and Rick Vetanovetz. 1999. The evolution of growing mix components. GMPro. September. p. 65, 67–69, 71.

18) Anon. 1999. Going coconuts. Ecological Landscaper. Winter. p. 12.

19) Evans, Michael R., and Robert H. Stamps. 1996. Growth of bedding plants in sphagnum peat and coir dust-based substrates. Journal of Environmental Horticulture. December. p. 187–190.

20) Van Meggelen-Laagland, Incke. 1996. Coir media: the newest peat substitute? GrowerTalks. August. p. 96, 98, 103.

21) Webber, Charles L. III, Julia Whitworth, and John Dole. 1998. Kenaf core as a potting mix component.

22) Ehret, David L. et al. 1998. Clay addition to soilless media promotes growth and yield of greenhouse crops. HortScience. February. p. 67–70.

23) Warren, S.L., and T.E. Bilderback. 1992. Arcillite: effect on chemical and physical properties of pine bark substrate and plant growth. Journal of Environmental Horticulture. Vol. 10. p. 63–69.

24) Anon. 2001. Asbestos in vermiculite. B.U.G.S. Flyer. March. p. 6–7.

25) Byczinski, Lynn. 2001. Safety of vermiculite still in question. Growing for Market. July. p. 9, 14.

26) Barringer, Sam. No date. Mad Cow Disease Information: Questions and Answers About Bovine Spongiform Encephalopathy (BSE). West Virginia University, Cooperative Extension.

27) Anon. 2000. Guidelines and Standards for the Grower for Demeter Biodynamic Certification and In-Conversion-To-Demeter. Demeter Association, Aurora, NY. p. 8.

Appendix 1

Sources of Organic Potting Media, Untreated Peat Moss, Coir, and Other Approved Ingredients

It bears repeating: Organic producers should always consult their certification agents before purchasing brand name products, especially those with unfamiliar ingredients.

Beautiful Land Products
P.O. Box 179
West Branch, IA 52358
1-800-227-2718
blp@beautifullandproducts.com

Web site states that all potting media meets criteria for organic certification.

Cashton Farm Supply
199 Front Street
Cashton, WI
608-654-5123
organic@cfspecial.com

Long-time supplier of products to organic farmers — organic fertilizers, non-organic potting mixes.

Johnny's Selected Seeds
955 Benton Ave.

Winslow, ME 04901
207-861-3900
staff@johnnyseeds.com

Compost-based organic fertilizer products (two kinds).

Lambert Peat Moss, Inc.
106 Lambert Rd.
Riviere-Ouelle, QB
G0L 2C0 Canada
418-852-2885
1-800-463-4083 (U.S.)
418-852-3352 FAX
info@lambertpeatmoss.com

Produces OMRI-Listed peat moss products: Jeff's Natural Solution, Ferti-Lome Pure Canadian, Lambert Canadian, and Canadian Gold.

Millenium Soils (Coir Div. of Vgrove, Inc.)
111 Fourth Avenue, Ste. 371
St. Catherines, ONT L2S 3P5
Canada
905-687-1877
905-687-8635 FAX

Organic Mechanics Soil Company, LLC.
110 E. Biddle St.
West Chester, PA 19380
610-380-4598
mike@organicmechanicsoil.com

Manufacturer of organic, peat-free, compost-based potting soil, sold to independent garden centers, natural food stores, nurseries, and landscapers. Products include a Premium Blend (OMRI-Listed), Container Blend, Planting Mix and Germination Blend.

Peaceful Valley Farm Supply
P.O. Box 2209
Grass Valley, CA 95945
530-272-4769
1-888-784-1722
contact@groworganic.com

Long-time supplier to the organic community.

Seven Springs Farm
426 Jerry Lane, NE. Floyd County
Check, VA 24072
540-651-3228

540-651-3228 FAX
7springs@swva.net

Carries McEnroe Organic Farm growing mixes. Catalog claims these meet NOP requirements for organic production. Also carries asbestos-free vermiculite and perlite.

Sun Gro Horticulture, Inc.
425-641-7577
425-641-0138 FAX

Sun Gro manufactures about 20 different OMRI-Listed transplant media products. Most are marketed under the Sunshine, Sunny Grower, Alberta Rose, or Black Gold labels.

Superior Peat, Inc.
1700 Carmi Avenue
Penticton, BC V2A 8V5
Canada
250-493-5410
250-493-4475 FAX
sales@superiorpeat.com

OMRI-Listed products include Superior Peat Black Peat and Superior Peat Peat Moss.

Vermont Compost Company
1996 Main St.
Montpelier, VT 05602
802-223-6049
802-223-9028 FAX
sales@vermontcompost.com

Product brochure claims that all products are acceptable for organic production. Includes several potting mixes, composted manure, sphagnum, vermiculite, perlite.

Appendix 2
Recommended Guides for Learning to Make Potting Media

— For General Information on Potting Media —

Growth Media for Container Grown Ornamental Plants. Revised edition. Extension Bulletin 241. By Dewayne Ingram, Richard Henley, and Thomas Yeager. 1993 (reviewed 2003). 21 p. Published by the University of Florida, Gainesville, FL.

This publication can be downloaded from the University of Florida IFAS Extension website. Not available in hardcopy except as single copies to Florida residents via Cooperative Extension.

The Fruit, The Seed, and The Soil. John Innes Leaflets #1–9. By W.J.C. Lawrence. 1948. Published by the John Innes Horticultural Institution, Bayfordbury, Hertford, UK; printed by Oliver & Boyd, London. Order from Oliver & Boyd, 39A Welbeck Street, W.1, London, England.

— For Specialized Information on Organic Potting Media —

The New Organic Grower. 1995. By Eliot Coleman. Chelsea Green Publishing Co., White River Junction, VT. 340 p. (Chapter 14 is especially useful.) Available for $24.95, plus $3 for shipping and handling, from:

Acres USA
P.O. Box 91299
Austin, TX 78709
1-800-355-5313
512-892-4448 FAX

The Organic Gardener's Home Reference. 1994. By Tanya Denckla. Storey Communications, Pownal, VT. 274 p. (Chapter 1 is especially useful.) *Listed for $14.99. Available through most bookstores and online at www.amazon.com*

Organic Transplant Production for the Advanced Market Gardener. This was the title of a workshop given by Dr. John Biernbaum, Michigan State University, and Chris Blanchard, Rock Spring Farm, Spring Grove, Minnesota. It was presented March 2001 as part of the Organic University program offered by the Midwest Organic and Sustainable Education Service (MOSES) in conjunction with its Upper Midwest Organic Conference. Participants were provided with an excellent manual. MOSES plans to continue offering the University program and should be contacted regarding scheduling and availability of the manual. Contact:

MOSES
P.O. Box 339
Spring Valley, WI 54767
715-772-3153
moses@win.bright.net

Sustainable Vegetable Production from Start-up to Market. 1999. By Vernon Grubinger. Cornell Cooperative Extension, Ithaca, NY. 268 p. (Contains sections on composting and on transplant production.) *Available for $38, plus $6 for shipping and handling, from:*

NRAES
152 Riley-Robb Hall
Ithaca, NY 14853
607-255-7654
607-254-8770 FAX

Growing 101 Herbs That Heal. 2000. By Tammi Hartung. Storey Books, Pownal, VT. 256 p. (Includes author's favorite potting mix for starting herbs. Organic production.) *Listed for $24.95. Available through most bookstores and online at www.amazon.com.*

Appendix 3
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. Because the sources are diverse, units of measurement are also different. When the origin of a recipe is known, or further details and recommendations are known, they have been provided. Note that several recipes are intended for use with Ladbrooke "soil blockers." Soil blockers are hand tools designed to form free-standing blocks of potting soil, which serve as a substitute for peat pots, seedling flats, etc. The system has been popular among small-scale producers. One source of soil blockers is:

Peaceful Valley Farm Supply
P.O. Box 2209
Grass Valley, CA 95945
(530) 272-4769.

The first recipe shown is a classic soil-based formula; the second is a soilless recipe based on the Cornell Mix concept.

Classic soil-based mix

- 1/3 mature compost or leaf mold, screened
- 1/3 garden topsoil
- 1/3 sharp sand

Note: This mix is heavier than modern peat mixes, but still has good drainage. Compost promotes a healthy soil mix that can reduce root diseases. Vermiculite or perlite can be used instead of sand. Organic fertilizer can be added to this base.

Organic substitute for Cornell Mix

- 1/2 cubic yard sphagnum peat
- 1/2 cubic yard vermiculite
- 10 pounds bone meal
- 5 pounds ground limestone
- 5 pounds blood meal

The following four recipes were found in the March–April 1989 issue of the Ozark Organic Growers Association Newsletter. The formulas are credited to the Farm and Garden Project at the University of California, Santa Cruz.

Seedling mix for Styrofoam seedling flats

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

Sowing mix

- 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.

Prick-out mix for growing seedlings to transplant size

- 6 parts compost
- 3 parts soil
- 1 to 2 parts sand
- 1 to 2 parts aged manure
- 1 part peat moss, pre-wet and sifted
- 1 to 2 parts leaf mold, if available
- 1 6-inch pot bone meal

Special potting mix

- 1 wheelbarrow-load sifted soil
- 1 wheelbarrow-load aged manure
- 1 wheelbarrow-load sifted old flat mix
- 5 shovelfuls sifted peat
- 2 4-inch pots bone meal
- 2 4-inch pots trace mineral powder
- 2 4-inch pots blood meal

The following recipes are taken from John Jeavons's *How to Grow More Vegetables...*, Ten Speed Press, Berkeley, CA.

Classic planting mix

One part each by weight:

- compost (sifted, if possible)
- sharp sand
- turf loam (made by composting sections of turf grass grown in good soil)

Note: the mixture should be placed in growing flats on top of a 1/8-inch layer of oak leaf mold to provide drainage. Crushed eggshells should be placed between the leaf mold and compost for calcium-loving plants like cabbages and carnations.

Simple soil flat mix

Equal parts by volume:

- compost
- bed soil (saved from a biointensive production bed during double-digging process)

The next three formulas are credited to the 1992 NOFA-NY Organic Farm Certification Standards.

Classic formula for horticultural potting mix

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

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

Recipe for soil blocks

- 20 quarts black peat with 1/2 cup lime
- 20 quarts sand or calcined clay
- 20 quarts regular peat with 1 cup of greensand, 1 cup of colloidal phosphate, and 1 cup blood meal
- 10 quarts soil
- 10 quarts compost

Note: all bulk ingredients should be sifted through a 1/2-inch screen.

The following four recipes are credited to Eliot Coleman. The first was published in the Winter 1994 issue of NOFA-NJ *Organic News*, in an article by Emily Brown-Rosen. The remaining three are adapted from Coleman's book *The New Organic Grower* (see **Appendix 2**).

Organic potting mix

- 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

Blocking mix recipe

- 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.

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

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.

The next recipe and details come from John Greenier, of Stoughton, Wisconsin. They were published in the January 1996 issue of*Growing for Market.*

Seedling mix for soil blocks or seedling flats

- 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).

The next two recipes were published in the September 1990 issue of *Greenhouse Manager* in an article entitled "Recipes for Success in Media Mixes," by Kathy Z. Peppler.

Growing mix for packs

- 40% topsoil
- 40% Canadian-type Michigan peat
- 20% perlite
- 5 pounds lime per cubic yard
- 3 pounds dolomitic lime per cubic yard

Note: The topsoil and peat are sterilized early in the fall, then brought indoors to be blended with the other ingredients and stored inside.

Growing mixes for pots and baskets

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

Note: The handling of this pot mix is the same as for pack mix.

The following recipes and instructions are from a workshop entitled "Getting Started in Organic Market Gardening," which was offered as part of the March 2001 "Organic University" program sponsored by Midwest Organic and Sustainable Education Services (MOSES) in conjunction with its Upper Midwest Organic Conference. The first is credited to Tricia Bross Luna Circle Farm, Gays Mills, WI; the second is credited to Steve Pincus, Tipi Produce, Madison, WI.

Luna Circle recipe

- 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

- 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.

The following three recipes are adapted from a subchapter entitled "Using compost for container crops and potting mixes" in *On-Farm Composting Handbook*, by Robert Rynk, (ed.). 1992. PublicationNRAES-54. Northeast Regional AgriculturalEngineering Service, Cornell Cooperative Extension,Ithaca, NY. 186 p.

Vegetable transplant recipe

Equal parts by volume of:

- compost
- peat moss
- perlite or vermiculite

Bedding plant recipe

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

Container mix for herbaceous and woody ornamentals

Equal parts by volume of:

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

The following two simple recipes came from Mark Feedman, a practitioner of the Biodynamic-French Intensive system. The first mix was used with great success while doing development work in the Dominican Republic; the second is an adaptation used later in New Mexico.

Dominican Republic mix

Equal parts:

- fine loam soil
- sharp horticultural sand
- well-finished leaf mold

New Mexico mix

- 2 parts well-finished compost
- 2 parts good topsoil
- 1 part leaf mold

The remaining recipes in this appendix are of uncertain origin, but were published in earlier versions of ATTRA's *Organic Potting Mixes.*

Recipe #1

- 50 to 75% sphagnum peat moss
- 25 to 50% vermiculite
- 5 pounds ground limestone per cubic yard of mix

Recipe #2

- 6 gallons sphagnum peat moss
- 1/4 cup lime
- 4 1/2 gallons vermiculite
- 4 1/2 gallons compost
- 1 1/2 cups fertility mix made of:
- 2 cups colloidal (rock) phosphate
- 2 cups greensand
- 1/2 cup bone meal
- 1/4 cup kelp meal

Recipe #3

- 10 gallons sifted two-year-old leaf mold
- 10 gallons sifted compost
- 5 to 10 gallons sphagnum peat moss
- 5 gallons perlite
- 5 gallons coarse river sand
- 2 cups blood meal
- 6 cups bone meal

Recipe #4

- 40 quarts sphagnum peat moss
- 20 quarts sharp sand
- 10 quarts topsoil
- 10 quarts mature compost

- 4 ounces ground limestone
- 8 ounces blood meal (contains 10% nitrogen)
- 8 ounces rock phosphate (contains 3% phosphorus)
- 8 ounces wood ashes (contains 10% potassium)

Recipe #5

- 9 quarts compost
- 1 cup greensand
- 3 quarts garden soil
- 1/2 cup blood meal
- 3 quarts sharp sand
- 1/2 cup bone meal
- 3 quarts vermiculite

Recipe #6

- 1 part peat
- 1 part bone meal
- 1 part perlite
- 1 part compost (or leaf mold)
- 1 part worm castings (optional)

Recipe #7

- 2 parts vermiculite
- 3 parts peat
- 2 parts perlite
- 2 parts cow manure
- 3 parts topsoil
- 1/2 part bone meal

Recipe #8

- 15 quarts screened black peat
- 15 quarts brown peat
- 17 quarts coarse sand
- 14 quarts screened leaf compost
- 3 ounces pulverized limestone
- 9 ounces greensand
- 3/4 cup dried blood
- 3 ounces alfalfa meal
- 3 ounces colloidal phosphate
- 9 ounces pulverized bone meal

Recipe #9

- 10 pounds compost
- 30 pounds sphagnum peat moss
- 60 pounds white sand
- 8 pounds calcium carbonate
- 4 pounds soft rock phosphate
- 2 pounds sawdust

Recipe #10

- 70 pounds white sand
- 25 pounds sphagnum peat moss
- 5 pounds chicken manure
- 8 pounds calcium carbonate
- 4 pounds soft rock phosphate

NCAT would like to acknowledge OMRI staff members Cindy Douglas, Brian Baker, and Emily Brown-Rosen for their assistance in reviewing the original draft of this publication.

By Georrge Kuepper
NCAT Agriculture Specialist
and Kevin Everett, Program Intern

Reviewed October 2010
Paul Williams, Editor
IP112
Slot #61
Version 102810