POTTING MIXES FOR ORGANIC GROWERS

Vern Grubinger, vegetable and berry specialist
University of Vermont Extension

Soilless potting mixes have long been used for greenhouse production of bedding plants, vegetable transplants and container-grown ornamentals. By avoiding the use of topsoil, the risk pathogenic microorganisms in this media may be reduced, avoiding problems with diseases like damping-off. In addition, topsoil is relatively heavy and dense so it can contribute to poor aeration and drainage in a potting mix. Soil-less mixes should be formulated to have optimal physical and chemical properties that promote germination and healthy seedling growth.

Qualities of a good mix. Poor performance in a potting mix is costly, since greenhouse space is expensive and so is having to toss out some seedlings or replant entirely. Optimal mix characteristics include the right density and porosity to provide good aeration and also good water holding capacity; proper pH and enough available nutrients to get plants off to a good start, and the absence of excess salts and plant pathogens. On organic farms, the mix must not contain any prohibited ingredients.

Organic vs. conventional mixes. Generally speaking, all soilless potting mixes contain a 'base' ingredient, usually sphagnum peat, or sometime coir. These provide a good physical environment for root growth but are relatively inert in terms of nutrient content and biological activity. Other materials may be added to improve drainage, adjust density and/or alter water holding capacity, such as perlite, vermiculite or builder's sand. Ground limestone may be needed to raise the pH. Fertilizers are added to provide available nutrients and obviously that's where conventional and organic mixes differ. In addition, organic mixes typically contain mature compost to provide slow release nutrients and contribute to good physical and biological conditions for plant growth, whereas conventional mixes rarely contain compost.

Issues with compost in potting mix. In some ways, compost is like snowflakes – no two batches of compost are exactly alike. So while compost usually adds value to a potting mix, it can also add a measure of uncertainty about performance that is not the case with conventional mixes. Immature compost in particular can harm seedlings by releasing ammonia, or tying up nitrogen, or stunting growth because of organic acids that have not fully decomposed. To avoid these problems it is important to use only mature compost, and to buy it from a reputable source or to carefully make your own using a consistent supply of high quality ingredients.

It's a good idea to keep organic potting mixes warm and moist for a week or two before planting into them. That allows microbial activity to kick in, and can reduce potential potting mix problems by allowing excess ammonium or organic acids to dissipate.

Compost is rarely used by itself as a potting medium. Compost alone does not have the optimal water holding characteristics, and soluble salt levels may be higher than optimal for potting mix. Plus, high quality compost can be relatively expensive so it makes sense to dilute it with other ingredients like peat. Organic potting mixes are typically made with 20% to 50% compost by volume, depending on the type of crop that will be grown in the mix, the container size, and the growing conditions.

Common potting mix ingredients. Sphagnum peat moss is a stable organic material that holds 15 to 30 times its weight in water and decomposes very slowly. It contains about 1% N but little is released because it breaks down so slowly. It has a pH of about 4 so lime must be added to the mix to along with sphagnum peat, at the rate of 8.5 lb. per cubic yard of peat to neutralize the acidity.

Coir comes from coconut husks and is a waste product of the coco fiber industry. It has physical properties much like peat but a higher pH of about 6. It holds up to nine times its weight in water. It can have a high salt content.

Limestone is either calcitic (high calcium) or dolomitic (high magnesium; both are used to increase the pH of a mix but dolomite is preferable for supplying both Ca and Mg.

Vermiculite helps hold water and fertilizer in the potting mix, and it also contains some calcium and magnesium. It has a pH near neutral. Vermiculite comes in different grades; medium grade is usually used for starting seeds, a coarse grade may be used for larger plants.

Perlite is a volcanic rock that has been heated and expanded. It is lightweight, sterile and has a neutral pH. It can be used to improve reduce the weight of a potting mix and increase its aeration and drainage.

Coarse washed sand also called builder's sand can be used to add air space to the potting mix and increase its weight. It has a neutral pH and provides almost no fertility to plants. Sand may be used when added weight is needed for growing tall or top heavy plants that might fall over if grown in a lightweight mix.

Fertilizers for organic mixes. In some cases, compost can provide adequate amounts of nutrients for transplant production but usually some fertilizer is added to the mix, especially if larger plants are to be produced or if small cell sizes are used that will require relatively high levels of available nutrients in order to sustain plant growth over time. Common organic fertilizers to provide phosphorus include bone meal, bone char or rock phosphate; potassium can be provided by potassium sulfate, sul-po-mag or greensand; magnesium can come from epsom salts or sul-po-mag. In some cases a blended fertilizer may be used such as pelletized chicken manure compost but such materials are usually reserved for field use rather than potting mix due to their slower nutrient availability.

Nitrogen availability. Assuring sufficient N in a form plants can use is often a concern with organic potting mix formulations, as N release may be quite variable depending on the compost that's used and the extent to which it is source of nitrogen. Most organic potting mixes are supplemented with fertilizers sources such as blood meal, crab meal, fish meal, or plant meals like alfalfa or soybean to provide additional N to feed plants for several weeks or months. Note that Chilean nitrate is expected to be prohibited for use in organic production sometime in 2012.

Some growers water with fish emulsion or other soluble organic N fertilizers to keep their transplants 'growing on' if a mix has run out of available nitrogen. Re-potting some plants, like tomato seedlings, into fresh mix is another way to keep them growing well. When using blood meal, partially composted manure or poultry-manure based fertilizer be aware that these high N sources need some time to allow for microbial activity start breaking the organic forms of N and drive them to nitrate (the process called mineralization). If planted into too soon, when first wetted and just starting to break down, these materials may give off ammonia, organic acids and other compounds that can damage germinating seeds and young plants. It is best to moisten the potting mix at least a week or two before you plant into it, making sure it stays warm and allowing time for phytotoxic compounds to dissipate.

Many things can lead to poor germination, including a mix with excess salts, improper pH, unfinished compost, or nutrient imbalances. Old seeds, improper watering, and root disease can also be to blame.

Avoiding performance problems. While many growers have had success with compost-based potting mixes, the performance of such mixes, whether commercially produced or homemade, has sometimes been inconsistent. In the worst cases, growers have experienced significant financial loss due to poor seedling growth associated with a problem mix. Poor seedling growth in compost-based mixes can result from low levels of available nutrients, high levels of soluble salts, excessive density of the mix, and/or the lingering presence of the harmful byproducts of initial decomposition mentioned above. In some cases the problem is not due to the mix but to management issues, like cold temperatures, improper watering or root disease.

Test your mix. It is a very good idea to test your organic potting mix well in advance of using it. Send a sample to a soil test lab at a land grant university or at a private company that specializes in horticulture. Do not request a regular field soil test, since potting mixes differ from field soil; they are much higher in organic matter and usually much higher in available nutrient content. A potting soil test will also measure soluble salts (electrical conductivity) and nitrogen in the nitrate and ammonium forms, which a field soil test doesn't.

ANALYSIS OF SATURATION EXTRACT

pH: 6.9
Soluble Salts (mS/cm): 2.27

Macronutrients	mg/L
Nitrate-N (NO3-N):	162
Ammonium-N (NH4-N):	3
Phosphorus (P):	8
Potassium (K):	112
Calcium (Ca):	211
Magnesium (Mg):	116
Sulfur (S):	96

Micronutrients	mg/L
Zinc (Zn):	0.04
Boron (B):	0.18
Manganese (Mn):	0.04
Copper (Cu):	0.10
Iron (Fe):	0.69
Sodium (Na):	83.19

Growers should use the low cost saturated media extract test (also called greenhouse media test), to get data on the pH, soluble salt, and nutrient levels of potting mix well in advance of planting. Here are the results of one sample.

The soil test to use for potting mixes is the saturated media extract (SME), also called a greenhouse media test or soilless media test. Unlike field soil tests that extract nutrients with weak acid solutions, the SME sample is mixed with distilled water at a standard dilution and then analyzed. Since different labs may use different dilutions, stick with one lab. To get an accurate reading, be sure that the potting mix has been moist and warm for at least a week prior to sampling. Most labs require a pint of mix to work with, and turnaround time is similar to a regular soil test, a week or two. It's a good idea to test each batch of potting mix, and to be able to compare results from mixes that performed well to those that didn't. The cost is low, about $15 or $20 per SME sample.

Table 1. General information guidelines for greenhouse growth media analyzed by the Saturated Media Extract (SME) method.

Analysis	*CATEGORY*				
	Low	*Acceptable*	*Optimum*	*High*	*Very High*
Soluble Salt, mS/cm	0-.75	.75-2.0	2.0-3.5	3.5-5.0	5.0 +
Nitrate-N, ppm	0-39	40-99	100-199	200-299	300 +
Phosphorus, ppm	0-2	3-5	6-9	11-18	19 +
Potassium, ppm	0-59	60-149	150-249	250-349	350 +
Calcium, ppm	0-79	80-199	200 +	-	-
Magnesium, ppm	0-29	30-69	70 +	-	-

The information in this table was developed at Michigan State University in the 1980's. Keep in mind that some crops such as herbs are more sensitive to salts and require lower nutrient levels for good growth than other crops like tomatoes which can tolerate more salts and will respond to higher nutrient levels.

'Bioassays' are another way to test the quality of a potting mix. All you have to do is sow some fast-growing crops in the mix several weeks before you plan to use it. Cress, oats, beans are just a few to consider. Some growers also like to test their mixes with slower-growing crops. Onions can be useful for bioassays as they seem to require a very high quality mix for good germination and growth. It makes sense to include any key crops that you grow as part of your bioassay.

Compare potting mixes. Without a side by side trial, it's hard to evaluate the relative performance of your current potting mix. So even if you have one you like, plant a few trays of the same seeds using another potting mix brand or recipe. It may surprise you to see how poorly your plants do next to a different formulation.

If things go wrong. Go ahead and submit sample(s) for SME testing; better late than never. Having this data in hand is part of the process of elimination to identify the problem. Is the pH off? Are soluble salts too high? Is there sufficient available N for plant growth? Once you have that data in hand, contact your potting mix supplier and ask if others growers have reported problems. A good supplier will appreciate communication from their customers, and be able to provide technical advice.

"Buying potting mix from a company like ours means you are buying into a network of organic growers" says Karl Hammer, owner of Vermont Compost Company. "That has great value for both buyers and sellers of the product. Sometimes I get a call about a problem but when I follow up with other growers using the same mix to grow the same crops I find that they have no issues. Then it's probably related to a greenhouse management practice. In fact, ninety percent of the problems I see have to do with over-watering in short daylight and cold weather conditions. Overwatering cools the growing medium, reducing microbial activity and root growth, and it can leach out available nutrients. It's much better keep your growing medium on the dry side, and if possible, provide bottom heat. Over-the-top watering by hand with cold water creates a lot of plant growth problems in organic potting mixes."

For information on organic potting mixes, including a number of recipes developed by farmers, see the eOrganic web site: http://www.extension.org/pages/20982/organic-potting-mix-basics

Revised 2-1-12