Steam Pasteurization of Growing Media

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Although the use of peatlite mixes and other components has gained widespread acceptance in greenhouse operations, there are a number of situations where treatment of soil or growing medium components is needed to produce quality plants.These include:

1. Applications where soil is one of the components.
2. Reuse of the growing mix for subsequent crops.
3. Situations where the mix has been contaminated.

Steam has long been considered the best treatment agent for growing media. It will destroy fungi, bacteria, nematodes, insects and most weeds. Its effectiveness is evaluated simply by measuring the medium temperature and the length of contact time.

Dry heat, flame or electricity is frequently used for treating small quantities. Uniform temperature is difficult to achieve with most treating equipment because the intense heat is applied over a small area, and heat transfer is slow.

Chemicals, mainly methyl bromide, are less effective and dangerous. It is likely that they will be removed from the market soon.

The lethel temperatures necessary to eradicate soil pests are shown in Table 1. Good results can be obtained with a temperature of 160° to 180°F for 30 minutes. A probe-type thermometer works well for measuring temperature.

The amount of heat needed to raise the temperature of a given volume of growing media depends on the components, its moisture content and the difference between the cold soil temperature and desired treatment temperature. The heat flow rate needed per minute depends on how quickly the mix must be brought up to the desired temperature. For most

applications, 30 minutes heating time and 30 minutes contact time is considered the norm.

When water is heated and turns to steam, 970 BTUs of heat are absorbed in the phase change. The volume also increases 1,600 times. When steam is injected into the medium, the 970 BTUs of heat are released as the steam condenses back to water.

Of the two methods used for soil treatment, free-flowing steam is the least expensive, considering equipment costs, but aerated steam is the most effective.

When steam leaves the boiler, it is under slight pressure (5 to 15 psi). As soon as it is released into the growing mix, it drops to atmospheric pressure, giving up its heat and, at this point, is considered free flowing. As long as the injection rate does not exceed the rate that it can condense (about 18 lbs/hr/sq ft of exposed medium surface), blowout does not occur. The medium should be well mixed, having uniform moisture and be level in the container or bench. Disadvantages to free-flowing steam include overkill of the microflora because of the high temperature, increase in total soluble salts and changes to the soil structure.

In the aerated steam method, steam from a boiler is combined with air from a high pressure blower to create a 140° to 160°F mix that is forced through the growing media. Advantages include an approximate 40% reduction in the quantity of steam needed and a more rapid, even heating of the mix. By turning off the steam and continuing the air flow, the temperature can be lowered rapidly by evaporative cooling.

With proper design, the system can be adapted to treat batches or continuous flow. For batch mixes, the air/steam mix is typically exhausted into a chamber below a perforated floor of a bin, cart or truck body. A fabric cover is used to hold in the heat but allow the air to escape. Manufacturers such as Lindig Corp., P.O. Box 130130, Roseville, MN 55113, and Sebring marketed by Dura Green Marketing Inc., P.O. Box 1486, Mount Dora, FL 32757, have equipment that matches boiler and blower capacity.

Bed or bench treatment is best done using a perforated pipe laid in the bottom. Steam supplied on the top of a bed is limited to about 8" depth of penetration.

A comparison of the amount of steam needed for different growing mixes is shown in Table 2. The amount of each component and moisture content affect the steam needs. In the free-flowing system the soil would be heated to 212°F, whereas the aerated steam system can achieve essentially the same level of pasteurization at 160°F.

Cold soil or wet soil will require more BTUs of heat and, therefore, a longer treatment time. Frozen soils are very difficult and slow to steam. Remember that a large amount of heat is required to change water from the solid to liquid form.

Boiler capacity needs to be matched to the quantity treated at one time. Too small a capacity will extend the time and result in a wet soil. Too large a capacity can cause blowouts creating an open channel for the steam to escape.

Table 1. Temperature necessary to kill soil pests

115°F	Water molds (*pythium* and *phytophthora*)
120°F	Nematodes
135°F	Worms, slugs, centipedes
140°F	Most plant pathogenic bacteria
160°F	Soil insects
180°F	Most weed seeds
215°F	Few resistant weed seeds and plant viruses

Table 2. Amount of Steam Needed for Growing Media Treatment*

Growing Media	*Free-flowing Steam lb/cu ft*	*Aerated Steam lb/cu ft*
Soil	10.8	6.3
Soil/peat/sand	7.5	4.4
Soil/peat/perlite	6.8	4.0
Peat/perlite	9.7	5.7
Peat	11.2	6.5

*Assumes:
Field capacity moisture content
Saturated steam—230°F
Aerated steam—160°F
Soil temperature—60°F
Air—70°F; 50% RH
Efficiency of boiler/piping system—50%