SOIL STERILIZATION METHODS FOR THE INDOOR GARDENER

BY G. M. FOSLER
UNIVERSITY OF ILLINOIS COLLEGE OF AGRICULTURE
EXTENSION SERVICE IN AGRICULTURE AND HOME ECONOMICS

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EXPERIENCED GARDENERS FIND IT sound practice to use only sterilized soil mixtures for growing pot plants and germinating seed. You can't depend on any of the incorporated ingredients — garden loam, organic matter, or sand — to be sterile. Sterilization kills soil-borne disease organisms (bacteria and fungi), weed seeds, and various pests such as insects and nematodes. It is a most important step in your sanitation program, and will aid you in growing healthy, vigorous plants for your home. To avoid recontamination, you should also sterilize all pots, flats, and tools that you will use.

Successfully growing plants indoors is difficult under the best of circumstances — so why not eliminate as many hazards as possible at the very beginning? Soil sterilization gives a good measure of protection against plant ailments caused by organisms carried in the soil. But don't expect diseased plant materials to become healthy or to be "cured" when planted in sterilized soil. Disease-producing bacteria and fungi can sap the strength of potted plants or even kill them, and insects and nematodes often severely weaken a plant through the damage they do to the root system. Damping-off fungi, almost always present in unsterilized soils, frequently rot seeds and cuttings and cause young seedlings to topple over and die. The use of sterilized soil is one good precaution against damping-off.

Sterilizing small batches of soil is a bothersome chore, but it is worth the effort. First, put the soil to be sterilized through a coarse sieve to pulverize it and to remove debris. The soil should be sufficiently moist to stick together when compressed in the hand, but dry enough so that it crumbles apart readily. You can treat a year's supply of soil at one time. After treatment, thoroughly air the soil for a few days, then store it in tight containers for later use.

Soil can be sterilized either by heat or chemicals, although heat is usually considered the most effective. Of the methods described in this circular, select the one best suited to your needs, or the one you can use with the equipment you already have. Since sterilization of soil by heat (particularly the Oven, Pressure Cooker, and Steam methods) tends to release nutri-
ments, you should use some caution the first few weeks in fertilizing plants potted in heat-treated soil. Proper moisture level is also very important in soil to be sterilized with heat. If too dry, heating may not be uniform and sterilization will be incomplete. When too wet, soil heats up very slowly.

If sterilizing at home is out of the question, your local greenhouse operator can probably supply you with sterilized soil. He is likely to have the proper equipment for this operation, and may even be willing to treat soil mixtures you have prepared yourself.

**STERILIZATION BY HEAT**

**OVEN STERILIZATION**

Here is a method anyone can use, and it is fairly satisfactory when directions are followed carefully. The soil should be loose and moderately moist as described above. Use a deep baking pan or roaster (aluminum, glass, or iron). Do not put more than 3 or 4 inches of soil in the pan. Level the soil, then cover the pan with heavy aluminum foil and seal down the edges. Punch a small hole through the center of the foil and insert the bulb-end of a meat or candy thermometer into the exact center of the depth of soil.

Set the oven at 250° to 275° F., then check the soil temperature at frequent intervals. When it reaches 180° F., reduce the oven setting to about 180° to 200° F. and keep the soil in the oven for another 30 minutes. Then remove the pan and let it cool. Avoid very high oven temperatures—they burn organic matter and humus from the soil and destroy soil structure.

The main objections to the oven method are the time involved, the tendency for the soil to dry or “bake,” and the odor. If you have a utility stove in the basement or laundry room, by all means do the job there. Use a thermometer if at all possible. If you don’t have the proper type of thermometer, a medium-sized potato can be used as a rough guide. Put the potato into the pan with the soil. When the potato is done, the soil should be more than adequately sterilized.
PRESSURE COOKER

With pressure. Soil can also be sterilized in a large home-canning type pressure cooker. Put several cups of water in the bottom of the cooker. Scoop the moistened soil mixture into shallow pans (no more than 2 to 3 inches deep). Level, but don’t tamp or firm. Stack the pans on the rack inside the cooker, separating each pan with lath strips for free circulation of steam. Close the lid, but don’t tighten the steam valve completely until all air is forced out and live steam is escaping. When the pressure has reached 10 pounds, run at this level for 15 minutes, then turn off the heat. Gradually open the steam valve, and remove the pans of soil when they are cool.

The main objection to this method is that temperatures run very high in a pressure cooker and may oversterilize the soil. (See paragraph 1, page 6.) For example, at 15-pounds pressure the temperature is about 250°F; at 10 pounds, 239°F; and at 5 pounds, 227°F. But if the soil is too deep in the pans, there is also danger that the centers of the soil masses may not reach a high enough temperature in the time allowed.

Without pressure. Here is another way to use your pressure cooker that overcomes the danger of excessive temperatures. Pour about a gallon of water into the cooker. Use a rack to hold the soil pans up out of the water. Put in the shallow pans of soil (prepared as described above under “With pressure”) and clamp on the lid, but leave the steam valve slightly open. Apply sufficient heat to keep the water boiling, and open the valve just enough so that it holds in steam but prevents any appreciable pressure from building up. When live steam begins to be forced out, continue to apply heat for another 30 minutes. Again—keep the cooker closed and don’t remove the soil until it is cold. (Caution: if all the water boils away, your aluminum cooker may be damaged or ruined.)

A large laundry boiler or kettle with a lid is also satisfactory for this method. Keep the lid on to hold in steam, but never clamp it on so that no steam can escape. This could lead to a serious explosion.
HOT WATER

This is a poor method, being practical for only a small volume of soil in a rather shallow layer. It is necessary to use a pot or flat that has good drainage and yet won’t let the soil wash out. Have the soil mixture friable and loose. Level the surface, and cover with a piece of burlap. Drench with quantities of boiling water poured through the burlap. Insert a thermometer into the soil, with the bulb near the bottom. Continue drenching until the temperature reaches 180° to 200° F. Allow to cool slowly.

Not only is a great deal of hot water used in this method, but the soil ends up saturated and badly puddled. A considerable amount of time is needed to get the soil dried out enough for use, sterilization may not be complete, and nutrients are leached badly. Above all, it is a messy procedure.

STEAM

Your florist almost always uses steam for sterilizing soil. This, by all odds, is the best method—but it is seldom practicable in the home. Don’t try it unless you are sure you have the proper equipment and plenty of steam. Sometimes one can tap into a low-pressure home steam-heating system, or use a portable steam generator of some kind.

For holding the soil, get a sturdy, tight wooden or metal box of appropriate size (perhaps 18” x 24”). Run steam into the box through a heavy-duty rubber garden hose. Insert the hose-end through a small hole drilled near the bottom center of one end of the box. Inside, let the hose extend loosely into a piece of perforated down-spouting that lies on the bottom and runs the length of the box under the soil. Have the perforations fairly close together. It’s a good idea, too, to drill a few small holes in the bottom of the box to drain away condensation moisture.

The soil in the box should not be more than 10 to 12 inches deep. Too much soil takes a long time to heat, and may be beyond the capacity of your steam source. Have the soil moderately moist—about as moist as for potting. Cover with a lid or piece of canvas. When steam enters the downspouting, it radiates uniformly out through the soil mass.
Check soil temperatures frequently with a dairy-type metal thermometer or a long glass alcohol thermometer. Leave steam on until all parts of the soil have reached at least 180° to 200° F. and remain within that range for 30 minutes. Don't oversterilize by letting temperatures build up much over this level or by leaving the steam on too long. When the soil is cool, it can be used immediately.

Sterilize clay pots, flats, and tools by laying them on top of the soil and under the cover.

**BOILING**

Soil is never sterilized by boiling. This is one of the easiest ways, however, to sterilize porous clay or glazed pots. First, wash the pots thoroughly; then boil them for 30 minutes in water. Don't put plastic pots into hot water unless you are sure they won't soften or melt. Although most tools should not be put into boiling water, thoroughly washing them in hot water with detergent is helpful. Dipping in a formaldehyde solution is also effective (see Formaldehyde — Liquid form).

**CHEMICAL STERILIZATION**

**FORMALDEHYDE**

Liquid form. You will find formaldehyde easy to use and fairly satisfactory. This material can be bought at a reasonable price at any drugstore. Sometimes known as formalin, it contains 37- to 40-percent formaldehyde in water. This method of sterilizing soil, while not as complete as the heat methods, is effective against some bothersome fungi (including damping-off organisms) and bacteria, soft and germinating weed seeds, and insects. About 2½ to 3 tablespoons of formaldehyde, diluted with four times that much water, are sufficient for 1 bushel of soil (32 quarts). Use somewhat heavier dosages for very heavy or mucky soils.

Have the soil moist and loose. Sprinkle the diluted formaldehyde on the soil and mix it in thoroughly. Put the soil into a box or can, or leave in a compact pile. Put tools on top of the soil, and cover tightly with a piece of plastic or canvas to hold
in all fumes for at least 24 hours. The spot you choose for this operation should be fairly warm, with the temperature of the soil to be treated at least 65° to 75° F. Because the fumes are toxic, keep well away from plants and animals. Remove cover and air the soil by working it occasionally. Be sure all fumes are gone before seeding or planting into it.

Soil in a coldframe, seed flat, or unplanted flower bed outdoors can be treated with a formaldehyde drench to alleviate disease and soil-borne pest problems. Work the soil loosely and have it fairly moist. Add 1 gallon of formaldehyde to 50 gallons of water, or 1 cup to 3 gallons, and apply ½ to 1 gallon to each square foot of soil. Cover the treated area with a panel of canvas, plastic, or sisalkraft paper, and leave on for two days. This treatment is most effective when the soil is warm. Uncover, and allow to air for a week or two. Working the soil with a hoe will help fumes to escape. Do no planting until all formaldehyde odor is gone.

You can also use a formaldehyde solution to sterilize tools and pots. Use 1 pint of formalin to 10 quarts of water. Immerse tools for about 5 minutes (pots twice as long) in the solution, then rinse in tap water. Dry tools thoroughly.

Dry form. Formaldehyde is also available in powder form, containing about 15 percent of the active material. Obtain and use only fresh dust. Mix 8 ounces to a bushel of soil, or 1 ounce to 4 quarts. Work thoroughly into well-moistened soil. Cover and handle as described for the liquid form.

OTHER SOIL FUMIGANTS

These volatile or gas-forming materials (chloropicrin, methyl bromide, carbon disulfide, ethylene dibromide, calcium cyanamid, sodium N-methyl dithiocarbamate dihydrate, etc.) are important temporary soil-sterilizing agents. Many of them contain either chlorine or bromine. They are sold in various forms and mixtures under several trade names, such as DD, Dowfume, Isocbrome, Larvacide, MC2, Mylone 85-W, Vapam, etc.

Although effective against certain types of pathogens and pests, few of these materials sterilize as
thoroughly as heat or steam. All of them should be used with great caution. They have other limitations too. In general, they can't be used indoors or in other confined areas. Chloropicrin (tear gas), for example, is quite toxic to plants and discomforting to animals and humans. Most other soil fumigants are extremely poisonous. Prolonged aeration of the soil is usually required after one of these fumigants has been used. The time varies, but the soil may not be usable for 5 to 20 days.

Use of these materials is not to be discouraged, but the home gardener will probably seldom want to buy them except for specialized purposes. They are most commonly employed in outdoor garden, lawn, and field soils. With proper precautions, they can also be used for smaller quantities of potting soil. Consult your extension specialist or farm adviser about available types and recommendations for their usage. Always follow the manufacturer's directions explicitly. *Keep these chemicals off your skin and clothing.*

**MISCELLANEOUS CHEMICAL AIDS**

A number of different materials can be applied as drenches around living plants to aid in controlling certain soil-borne fungus diseases. *But don't expect them to take the place of soil sterilization and good sanitation practices.* Some of the fungicidal materials useful as soil drenches are captan, ferbam, nabam, Natriphene, Pano-Drench, PCNB (Terraclor), Semesan, thiram, zineb, and ziram. Use these materials strictly according to the manufacturer's directions.

As a precaution against damping-off of seedlings, always treat seeds with a protective fungicide before planting. (See Circular 796, "An Easy Method for Germinating Flower Seeds," available from 110 Mumford Hall, University of Illinois, Urbana.)

By G. M. Fosler, Floriculture Division, Department of Horticulture