Portable Equipment for Steam Soil Sterilization

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A large number of the commercial greenhouse ranges in the country have hot water heating systems. Because of the expense and other problems involved in converting the hot water boilers for steam generation, operators have been hesitant about changing over for soil sterilization with steam.

Portable steam generating equipment offers an excellent solution to the problem for those growers who do not have steam heating systems. The features desired in such equipment, in addition to portability, are adequate capacity and low cost.

Steam-Flo Generator

One of the recent developments in portable steam generating equipment is the Steam-Flo Soil Sterilizer, manufactured by the Rough Brothers of Cincinnati, Ohio. One of these boilers was made available to the Floriculture Department at Cornell, and has been run through a series of trials, both in the Department's experimental range and in commercial greenhouses. The boiler is shown set up and in operation below.

For portability, the equipment is light and easy to handle; weighing only 950 pounds empty. Mounted on pneumatic tires set to clear a 42 inch door, the boiler can easily be moved to any desired location. Consequently soil can be steamed in place, thus eliminating much time and labor ordinarily involved in soil handling.

Steam is generated in a water tank heated by an oil burner which is mounted at one end. The flame is directed into a 9 inch tube making a double pass through the boiler. About 40 or 50 gallons of water can be evaporated per hour burning fuel oil at the rate of 4 to 4-1/2 gallons per hour. The water tank has capacity for about 2 hours of operation without uncovering the tubes. Since the boiler has had no automatic feed water attachment, water has been fed in through a hand valve when necessary to complete sterilizing. Recent word from the manufacturers indicates that an automatic feed water attachment is now available.

Trials have been run to determine the capacity of the machine in terms of area of bench that can be handled in a given length of time. These trials have included raised benches, ground beds, and outdoor soils. In all trials so far, the soil has been loosened, perforated pipe laid on the surface and the area covered with one of the plastic sterilizing covers.

The total time required for one operation can be divided into three periods. First there is the time to build up a head of steam on the boiler; second the period of time to heat the soil to sterilizing temperature, and third, the holding time at sterilizing temperature. The holding time is fixed; it is recommended that the soil be held at 180 degrees Fahrenheit for one half hour. The warm-up time for the boiler will vary according to the temperature of water to start, but on the average, it has required one-half hour for the Steam-Flo Sterilizer to develop a head of steam ready for sterilizing from water directly out the taps in the greenhouse.

The time required to heat the soil is the big variable and will depend on many factors including amount of soil handled at one time, temperature of the soil to start, and moisture content. With the boiler operating to capacity, for a given depth of soil the time required to raise the soil temperature will vary directly with the bench area handled at one time. For a given area, however, the time does not vary directly with the depth of soil. When sterilizing from the top, it takes considerably less time to heat the top 4 inches of soil than to heat the next 4 inches.

Trial Runs

Results of the trials at Cornell show that our Steam-Flo Sterilizer will heat 200 square feet of raised bench, 6 inches deep, to sterilizing temperature in 1-1/2 hours, starting with soil at 60 degrees. Adding boiler warm-up time and holding time, total operating time is 2-1/2 hours. In one trial on 300 square feet of ground bed in a greenhouse, 4 hours total time were required to sterilize the soil to the 5 to 6 inch depth. In an outdoor trial, on 150 square feet, a total time of 2 hours and 20 minutes was required to sterilize to the 6 inch depth.

On the basis of these results, the capacity of the machine can be roughly estimated. Any portable steam generating unit must, of necessity, have a limit as to capacity. Increased capacity can be gained at the sacrifice of portability.

Sterilizing Covers

The plastic covers recently developed for soil sterilization have been easy to work with and handle. This is one of the covers shown in place on a bench

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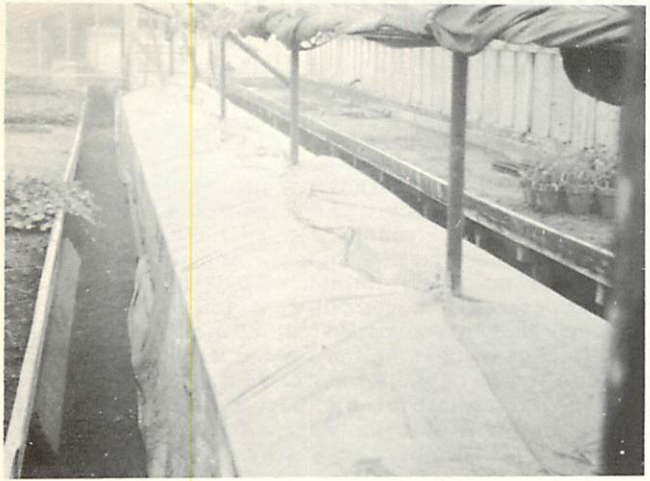

and "ballooned" with steam. This particular operation was chosen for illustration because the pipes down through the center of the bench presented a special problem. To cover the bench, two strips of cover cloth were used. Wires were stretched from post to post, the two strips lapped over the top of these wires and fastened with snap clothespins. No clamps or weights have been used to hold the plastics to the sides of the bench. Moisture under the cover "seals" the material to the bench; at the low steam pressure used, the seal was adequate to hold the cover to the bench. On the ground, however, the cover must be held in place by weights such as lengths of pipe or soil.

Many growers have the erroneous impression that they are holding considerable steam pressure under the sterilizing cover. As an illustration, suppose it were possible to obtain a steam pressure of 1 pound per square inch under a cover 100 square feet in area. If such were possible, there would be a lifting force of 144 pounds on every square foot of cover, and 14,400, or over 7 tons, on the entire cover. The conclusions that may be drawn from this are obvious. This should not, however, belittle the importance of steam pressure on the boiler. Pressure is needed to force the steam through the valves and piping to the bench and down the conduit on the bench. If the runs of pipe from the boiler to the bench are not excessively long, 8 to 12 pounds of pressure on the boiler should do a satisfactory job.

Moisture Important

Soil moisture content affects the time required to steam sterilize soil. Dry soil is an insulator and, consequently, resists the transfer of heat throughout the soil. On the other hand, in soil that is too wet, there is an excess of water which must be heated. The ideal moisture content for steam sterilizing has not yet been determined, but soil that is at the right moisture content for planting seems about right.

Soil sterilization by steam has many advantages. This method is readily adaptable to sterilization right in place in the bench or bed. One bench can be sterilized in a greenhouse even when growing plants are present in other benches. Soil can be planted after steam sterilization as soon as it has cooled. Whatever the method used, soil sterilization is a practice that should be considered in any successful growing program.

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