greenhouse situations. Preliminary measurements of each product are required to select the instrument reading (B, G, or R) that is most closely related to visual color.

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A Simplified Soil Temperature Regulation System[1]

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Abstract. **A flexible, inexpensive system for experimental control of soil temperature independent of "above ground" temperature is described. The system is based on the control of air temperature around soil containers in an insulated sealed chamber.**

One difficulty in studying the influence of temp on plant growth is the limited ability to control soil temp independent of air temp. Use of water baths is limited by the no. and size of soil containers that can be used and in equipment costs. The system described by Woltz (1) is quite satisfactory for some purposes but the contiguous nature of the tanks makes randomization of treatments impossible and the equipment lacks flexibility from one study to the next. Because of these limitations we developed and are using a system based on the control of air temp surrounding soil containers in a sealed chamber (Fig. 1).

Our chambers, 61 cm wide, 122 cm long and 41 cm high, were constructed from 0.6 cm (¼ inch) plywood with 2.5 cm (1 inch) styrofoam insulation on the bottom and sides. Pots are held in place by a 1.9 cm (¾ inch) plywood cover with holes cut to fit. Pots are supported by wooden strips on the lower side of the lid. Fiberglass insulation sheets with slits cut around the plant stem cover the pots to reduce temp fluctuations. The 61 cm x 122 cm chambers will accommodate 28 closely spaced 12.7 cm (5 inch) pots.

A refrigerated liquid bath serves as a common source of cooling for all treatments that are to be maintained at low soil temp. A ½ hp portable cooling unit and a 80 liter (20 gal) plastic container insulated with fiberglass have been satisfactory. For the cool soil treatments the air inside the chamber is cooled by pumping refrigerated ethylene glycol-water solution from the refrigerated bath through a 15.2 m (50 ft) long 6 mm (¼ inch) ID copper coil inside the chamber with a submersible pump. Tygon tubing is used to supply cold solution to the coil and return it to the bath. A thermostat controls the pump. Connection of the sensing element of the thermostat to the cooling coil near the feeder end of the coil results in very little fluctuation of air temp inside the chamber. The thermostat setting needs to be slightly lower than the desired soil temp to achieve optimum results when equilibrium is reached. The exact setting is determined by trial and error. Circulating fans inside the chamber help maintain uniform temp.

Several different soil temp regimes can be maintained lower than air temp "above ground" by use of the one refrigerated bath. Each unit would be controlled by its own circulating system and thermostat. Thus for example, a liquid bath maintained at 0°C could be used to control one unit at +5°, another at 10°, and another at 15°. However, fluctuations increase as soil temp varies from that of the cooling bath.

For the warm soil treatments a similar insulated chamber is used and air temp inside the chamber is maintained by use of thermostatically controlled electric heating cables.

Soil temp fluctuations in the center of 12.7 cm (5 inch) pots does not exceed ± 1°C when thermostats with a differential of 2° are used to control the cooling or heating.

Plastic bags placed over the bottom of the pots help to keep them from drying out and moisture from collecting on the cooling coils.

Since the temp level of each chamber is controlled independently great flexibility is possible. Any number or size chambers can be included as long as the cooling capacity of the refrigeration unit is sufficient. Thus the number of replications and soil temp treatments can be easily varied. Some units can be maintained at a given soil temp throughout the experiment and others changed at given intervals to coincide with different developmental stages of the plants.

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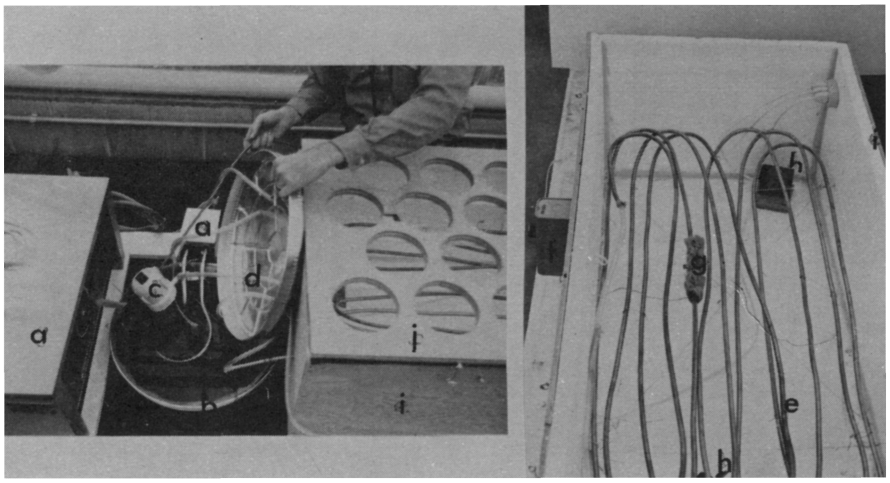

Fig. 1. Equipment for maintaining low soil temp; (a) portable cooling unit, (b) insulated water bath, (c) submersible pump for circulating coolant, (d) coolant supply line, (e) copper tubing cooling coil, (f) thermostat, (g) thermostat sensing element (connected to cooling coil), (h) fan, (i) plywood chamber insulated with styrofoam, and (j) lid for supporting pots.

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