terial plates may result in an easier and more effective means of growing and counting anaerobes in the laboratory than is employed presently.

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References and Notes

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28 June 1957

Growth Chamber with Light of Solar Intensity

Conventional plant growth chambers utilize primarily fluorescent lamps, which produce a maximum illumination of only 2000 to 2500 ft-ca (*1*). No descriptions have been found of chambers in which the intensities are comparable to those of full sunlight. Summer sunlight intensities in the United States at noon on relatively clear days range from around 9000 to 14,000 ft-ca, depending upon the exact time of year, altitude, latitude, and sky conditions. Therefore, experimental studies with plants having these high light requirements cannot be carried out in conventional chambers. This would include plants whose natural occurrence is restricted to open areas receiving full sunlight.

The performance of the chamber described in this report (Fig. 1) has been satisfactory, not only in its mechanically successful operation since November 1956, but also in that several herbaceous species requiring full sun for normal development have been grown from seedling to maturity without evidence of shade effects.

This chamber is a modification of an existing one, in which all parts except those required for illumination were present. It is 1.4 m wide, 1 m deep, and 1.1 m high. After a survey of commercially available lamps had been made, a battery of 36 G-E R-40 300-w reflector spots was chosen. The lamps were installed in porcelain bases having ball-and-socket joints (*2*), which were in turn clamped to a frame forming a square grid with 15-cm centers. Thus the bulbs were only 2.5 cm apart. Heat-resistant asbestos wiring was used throughout.

These lamps have an emissivity of 3500 total lumens and a nominal beam spread of 30 deg. The 10-deg center cone varies from 13,500 to 14,500 candlepower, with a drop to 6000 at the 20-deg circumference, and 2000 at the 30-deg circumference. Total lumens for a 10-deg cone are 330; for a 20-deg cone, 970; and a 30-deg cone, 1450. The approximate average initial intensity at 1.5 m is 560 ft-ca over a circle 23 cm in diameter, 440 ft-ca over a circle 45 cm in diameter, and 276 ft-ca over a circle 76 cm in diameter (*3*). The accumulated foot-candles from the overlapping intensity patterns of each of the 36 lamps varies from about 12,000 in the center of the grid to 8500 in the outer portion. Although intensities increase as the distance is reduced, the inverse square law does not hold because of the multiple light sources and the cone-shaped intensity pattern of each source. These calculated intensities have been verified by direct measurement. By slightly angling the lamps, the grid area at 1.3 m (on the floor of the chamber) can be made to receive almost uniform illumination.

The only other suitable sources located were mercury-type lamps such as the G-E B-H6 1000-w lamp of 65,000 lu, which is used in search-lights, and the G-E A-H9 3000-w lamp of 120,000 lu, which is used for high bay lighting. For some installations these lamps may be preferable to incandescent lamps. Drawbacks include the absence of built-in reflectors, the elaborate cooling system needed by the former and the size of the ballast for the latter. Uniform illumination would be difficult to achieve, and several lamps would be required for a chamber of the size described here. None of the street-lighting lamps investigated were satisfactory. Despite a range in size from 1000 to 25,000 lu these lamps were not small enough to permit the close spacing required to build up high intensities.

Approximately 70 percent of the energy used by a 300-w incandescent lamp is dissipated as heat energy. A water filter consisting of a box with 6-in. metal sides and a glass bottom was designed to remove most of this heat. Water inflow is through a perforated pipe across one side, and the outflow is through a series of holes drilled on the opposite side. Water depth is controlled by vertical spacing of the outlet holes.

In the range of wavelengths from 0.6 to 3.0 μ, the amount of radiation absorbed from sunlight by a layer of water 1 cm thick is 26.97 percent, while only 0.01 percent in the range from 0.2 to 0.6 μ is absorbed. For a layer 10 cm thick, 45 percent of the radiation from 0.6 to 3.0 μ is absorbed, while for a 100-cm layer, the amount of absorption is increased to only 63.34 percent. However, the 0.08-percent radiation absorbed in the range from 0.2 to 0.6 μ by a 10-cm layer is increased to 7.5 percent for a 100-cm layer (*4*). When a 10-cm layer is used in this chamber, heat radiation is reduced to a level comparable to that received from the sun. At 1.3 m from the source, radiation received is 1.1 g cal/cm^2 min, whereas at 0.9 m it is increased to 1.65 g cal/cm^2 min.

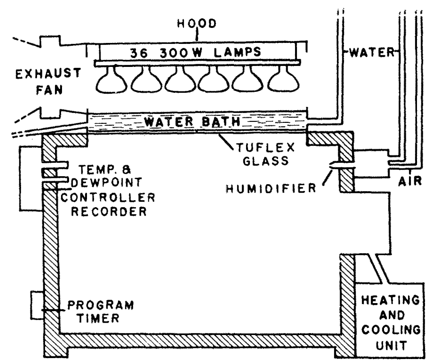

Fig. 1. Cross-sectional diagram of growth chamber 1.4 m wide, 1 m deep, and 1.1 m high.

The floor is composed of a ¼-in. sheet of tempered plate glass (*5*) which has four times the resistance to thermo shock and three to five times the resistance to impact shock of ordinary plate glass. This glass permits 90 to 93 percent transmission in the visible spectrum, with a cut off between 0.31 and 0.36 μ and a slow fall beyond 1 μ.

A Foxboro dewpoint temperature and humidity recording and controlling system is used, in connection with a 750-w heater and a 1 hp refrigeration unit, each operated with a fan for forced circulation. Moisture is supplied by an atomizer utilizing compressed air at a pressure of 30 lb/in.^{2} For most uses humidity control may not be necessary because of transevaporation, which occurs naturally within the chamber. A more satisfactory system, especially for low or high temperatures and humidities, would employ recirculating air, with the heating and cooling units located outside the box (*6*). It should be emphasized that Fig. 1 is diagrammatic and is thus suggestive of a variety of modifications.

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15 July 1957