

# LSU FORESTRY NOTES

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LOUISIANA STATE UNIVERSITY & A & M COLLEGE

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## A NEW SAND-CULTURE APPARATUS FOR TREE NUTRITION RESEARCH

Research in tree nutrition often necessitates the use of rather large-scale installations of sand-culture equipment. The apparatus described below was developed during the course of experiments at Louisiana State University and provided daily irrigation to 102 culture units of loblolly pine (*Pinus taeda* L.) for a period of 10 months. This apparatus is a modification of the one devised by Gauch and Wadleigh (1943), but some aspects of the system are thought to be original.

The Gauch and Wadleigh technique requires the use of a glazed earthenware crock beneath the greenhouse bench to serve as a reservoir for nutrient solutions. The nutrient solution is transferred by force of gravity from the reservoir to a small glass bottle which is periodically pressurized to force the solution into the crock in which the plants are grown. The present system eliminated the crock reservoir and is therefore simpler to install and maintain.

### Description and Operation of the System

Each unit (Figure 1) consisted of a 5-gallon glazed earthenware crock (1)<sup>1/</sup> filled with quartz sand (2) in which the plants were grown. On the floor beneath the crock was a 10-liter glass carboy (7) containing the nutrient solution (8). Size of the carboy can vary according to the amount of nutrient solution needed. A glass check valve (9) in the drain tube regulated filling and emptying of the crock. Except for slight variation in dimensions, the valve was identical to the one used by Gauch and Wadleigh (1943).

At daily intervals an electrically operated air compressor (Bell and Gosset, Model SYC9-1KC) was manually activated to force air into a network of galvanized iron pipe and rubber tubing leading to the solution carboys. To insure uniform distribution of pressure, each unit was equipped with a 1/2-mm capillary tube (10) through which the air passed. As the pressure in the carboy increased, the glass bead (9b) in the check valve (9) was forced downward, closing the valve. This in turn caused pressure in the carboy to increase, resulting in solution being forced through the delivery tube (5a) to the top of the crock above. At the upper edge of each crock the delivery tube was connected to a tubular polyethylene ring (3). The ring was perforated toward the center and buried 1 inch below the sand surface. This permitted an even distribution of the solution. If the cultures are to be irrigated to saturation, the perforated ring is unnecessary.

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<sup>1/</sup> Numbers in parentheses refer to the numbers in Figure 1.

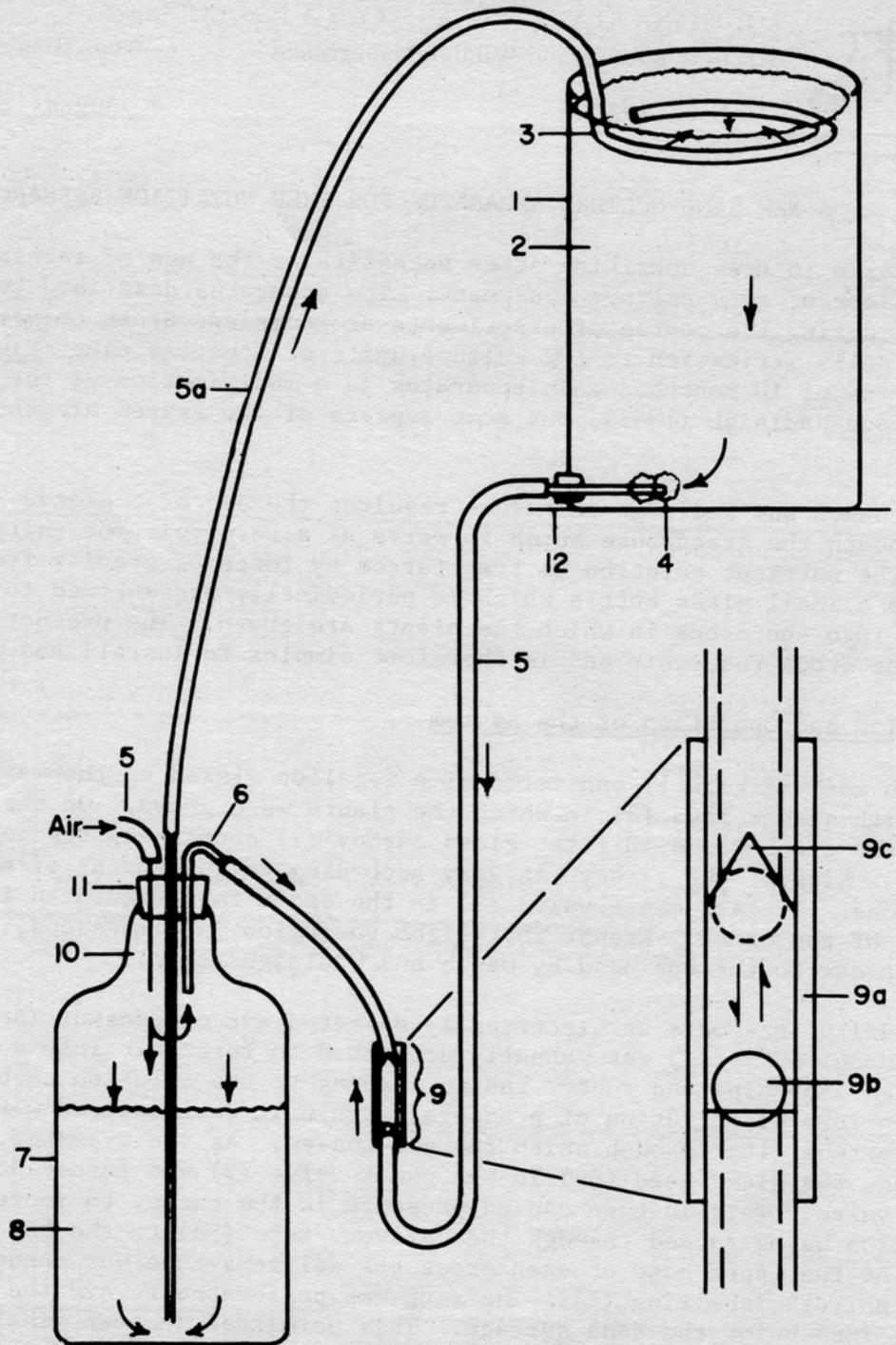


Figure 1. Diagrammatic representation of one unit of the sand-culture apparatus. Numbers are referred to in the text.

A time switch was installed and adjusted to break the circuit when irrigation was complete. The irrigation time depends on the desired quantity of solution per crock, number of units being irrigated simultaneously, air pressure at the compressor, and size of the solution carboys. With a pressure of approximately 5 pounds per square inch, 11 minutes were required to fill the 102 culture units in this experiment.

An orifice approximately 3 mm in diameter was allowed to remain open in the system at all times. Enough pressure was generated by the compressor to operate the system yet allow air to flow constantly through the opening. The orifice, which should be located at the most distant point from the compressor, allows the system to depressurize when irrigation is complete. Within 4 to 5 minutes after the compressor had been automatically stopped by the time switch, the pressure inside the carboys had decreased sufficiently to allow the pressure head of the solution in the crock (1) to lift the glass bead in the check valve from its closed position, permitting the solution to return to the carboy. A notch (9c) in the rubber tube at the upper end of the valve prevented the bead from sealing the opening and halting crock drainage.

All glass fittings exposed to sunlight were covered with black electrical tape to retard the growth of algae. Likewise, the glass carboys were painted black.

#### List of Components

In the following list, the numbers correspond to those shown in Figure 1:

1. 5-gallon glazed earthenware crock
2. Quartz sand, 20 mesh
3. Polyethylene distribution ring perforated with a dissecting needle
4. Glass-wool filter covering drain tube
5. Rubber tubing, 4 mm I.D.
6. Glass tubing, 5 mm O.D.
7. Glass carboy, 10-liter capacity
8. Nutrient solution
9. Check valve
  - 9a. Glass tube, 7 mm I.D. by 60 mm long
  - 9b. Glass bead, 5 mm diameter
10. Capillary tube, 1/2 mm I.D., 5 mm O.D. by 50 mm long to serve as a modulator of the air supply and insure uniform air pressure to all units
11. Rubber stopper, No. 6 with 3 holes
12. Greenhouse bench.

The previous description and list of materials are not to suggest that the specifications for the apparatus are rigid. On the contrary, the system can be varied to meet the needs of the researcher. For example, crock size could be larger or smaller, which would likely mean using a different-sized solution carboy. Such variations would no doubt also necessitate changes in tubing sizes as well as air pressure required to operate the apparatus. The researcher should construct the apparatus according to his own needs and, through preliminary trials, determine the air pressure, length of irrigation cycle, etc., that fit his particular situation.

Even though this system worked remarkably well with 102 culture units, a few crocks had a tendency to fill more rapidly than others. This problem was virtually eliminated by the use of screw clamps on the solution delivery tube (5a).

LITERATURE CITED

Gauch, Hugh G., and Cecil H. Wadleigh. 1943. A new type of intermittently-irrigated sand culture equipment. *Plant Physiol.* 18(4):543-547.

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