USE OF INFRARED HEAT IN A PROPAGATION ENVIRONMENT

SAM ALLEN

International Forest Seed Co.
P.O. Box 290
Odenville, Alabama 35120

International Forest Seed Co. (IFSCO) has an active program breeding loblolly pine for fusiform rust resistance. Controlled crosses of resistant parents were made in 1983–1985. Seedlings derived from these crosses have been established in cutting orchards.

During the winter of 1986–1987, a 108 ft. × 41 ft. propagation greenhouse was constructed at IFSCO's nursery near Odenville, Alabama, to root cuttings from the rust-resistant selections. Loblolly pine is a difficult species to root. The best rooting reported in the literature is 68% (2).

Greenwood *et al.* (1) reported that the distribution of mist accounted for 75% of the variation observed in rooting loblolly cuttings. For this reason we decided to use a fog system for propagation. The use of fog for propagation has been addressed several times in this and other publications so will be treated briefly here. We have been satisfied with a Mee system in operation for several years and decided to use the Mee II Cloud Fog System in the new facility.

Fog lines were placed 10 feet apart as were nozzles on each line. The system was also designed to aid in cooling. Nozzles were placed 18 feet apart along the air intake vent as suggested by the manufacturer. Fans were installed to exhaust 1½ volumes of greenhouse air per minute. As a general rule of thumb, greenhouses that utilize wet pads for cooling require one air exchange per minute. The manufacturer recommends one air exchange per two minutes.

This combination of fog volume and airflow was not adequate during the summer of 1987. Temperatures would exceed 100°F and foliage would dry during the heat of the day. Additional nozzles were installed and a travelling boom irrigator was run across the cuttings to keep the foliage wet.

The production system at IFSCO utilizes 40-cavity multipots, which are placed on growing frames. These frames, which hold 2,400 cavities, are then transported with a tractor and front-end loader. An under-gravel hot water heating system had not held up to the weight of the tractor, therefore, forced air and infrared heating options were assessed.

The primary advantage of infrared heat is lower energy consumption. An infrared system used 62% less fuel than gas-fired unit heaters with polyethylene convection tubes (3). Purported

disadvantages of infrared heat such as dense plant canopy causing cool soil temperatures and non-uniformity of heat distribution, we felt, would be reduced in a fogged environment.

A four burner-one exhauster Reflect-O-Ray infrared system manufactured by Combustion Research Corp. was installed. The system became operational in February, 1987. As of this writing, the heating system has only been in use for three months so adjustments are still being made.

On December 17, 1987, air and growing-medium temperatures were taken using a Standard Oil Engineering Plant Stress Monitor to evaluate heat distribution characteristics throughout the greenhouse. Medium temperatures taken across the width of the greenhouse revealed an average temperature differential of 5.5°F between warmest and coolest areas. Warmest areas were under the heat lines, coolest areas were near the outside walls and in the middle.

Growing medium temperatures averaged 3.8°F warmer than air temperatures just above plant height. This is because infrared systems heat solid objects, which then heat the air. Traditional forced-air systems heat the air which, in turn, heats solid objects. The comparatively warm medium temperature is advantageous to rooting, but the non-uniform heat distribution causes variable rooting responses.

Our system requires an 8-minute minimum burning period to purge acid, which can build up in the lines. This causes cycling of our temperature control system. During low heat requirement situations, 8 minutes of heating will trigger a cooling phase. This not only wastes heat but contributes to uneven temperature distribution.

Infrared heating systems have potential in a propagation environment but, however, are more appropriate in a northern climate where fuel savings could be better realized.

Acknowledgements. Thanks are given to Dr. Steven E. Newman, Assistant Professor, Mississippi Agricultural and Forestry Experiment Station, for assistance with infrared thermometry and data collection.

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