period of time. We feel this is due to contraction of the components followed by the sudden pressure exerted on the line during the first mist cycle. This only occurs on a small percentage of fittings. Under these cooler conditions, we daily replace only between 5 to 20 out of 1728 possible connections. We have dealt with this by scouting our unheated greenhouses for separated fittings at 10:30 AM November through March. This involves a little labor, but since walking through the houses is a daily routine, it is not out of the way. It is important to note that separation of fittings has not been a problem in houses were we can maintain moderate temperatures.

CONCLUSION

Use of Israeli low-volume irrigation has allowed Gilbert's Nursery to increase its effective propagation space without bringing in an additional water source. We are now servicing all propagation houses 2892 m^2 (31,128 ft^2)—plus offices and bathrooms with one well. We do realize that we have once again stretched this well to its limits. We are currently developing a layout that will tap into our recycled pond water. This water, which is already being chlorinated, will then subsequently pass through a bromine filter before it flows into our propagation houses. This "double" filtration will give us adequate protection against pathogens. The recycled water will give us an unlimited volume from which to operate, and the irrigation equipment we have adopted will serve the growing needs of Gilbert's Nursery for years to come.

Unique Bottom-Heat System for Propagation of Ornamentals

Marla Townsend
Hawksridge Farms, Inc., P.O. Box 3349, Hickory, North Carolina 28603

INTRODUCTION

Hawksridge Farms, Inc. was established in 1982. At present, we are approximately a 24-ha (60 acre) container nursery. We have 35 full-time and 15 seasonal employees. Of these employees, four full-time employees and three seasonal work in propagation.

We grow approximately 650 taxa of trees, ornamental shrubs, needled evergreens, ornamental grasses, bamboo, vines, and perennials. We propagate approximately 75% of what we grow.

The nursery has had a propagation facility since it began. However, 1983 was when the first bottom heat house was built. Several other nurseries were visited, and a lot of ideas were synthesized in development of the bottom heat system we utilize at our nursery. A few changes have been made over the years, but the basic concept has stayed the same.

The main crop used in our bottom heat houses is our needled evergreens. We grow a lot of upright conifers that would be hard to root if we did not use bottom heat. We grow approximately 100 cultivars of needled evergreens.

PROPAGATION SYSTEM DESIGN

The propagation house we use is a Jaderloon 8.5 m × 29 m (28 ft × 95 ft) quonset greenhouse frame. It is covered with a double layer of 6-mil polyethylene film, and a 47% shade cloth is put on top.

Our third bottom-heat house was built in Fall 1994. A layer of gravel approximately 7.6 cm to 10.2 cm (3 to 4 in.) deep is placed in the house before the beds are constructed. The gravel size is 1.3 cm (0.5 in.) in diameter. The 8.5 m × 29 m (28 × 95 ft) house has two beds along the sides, which are each 0.9 m (3 ft) wide and 27.4 m (90 ft) long. In addition, there are two island beds down the middle of the house, which are each 1.8 m (6 ft) wide and 26.5 m (87 ft) long. There is sufficient space at each end of these two middle island beds to walk around them.

On the sides of the beds are 5.1 cm × 30.5 cm (2 in. × 12 in.) treated boards that are placed lengthwise on the gravel — which makes the beds 30.5 cm (12 in.) deep. A 5.1 cm × 15.2 cm (2 in. × 12 in.) board is placed every 0.9 m (3 ft) on the gravel to help hold the bed together and also to secure the bottom heat pipes and mist lines. The bottom heat pipes [1.3 cm (0.5 in.) CPVC] are placed 15.2 cm (6 in.) apart. A 0.9 m (3 ft) bed would have six pipes, three for supply of the hot water and three for return to the boiler. These pipes are held in place with clamps on each 5.1 cm × 15.2 cm (2 in. × 6 in.) board.

Approximately 15.2 cm (6 in.) above the gravel another board is placed every 0.9 m (3 ft), and 12.5-gauge woven field fence is placed on top of this board. The woven field fence is fastened with "U" nails. Twenty-seven gauge screen wire is placed on

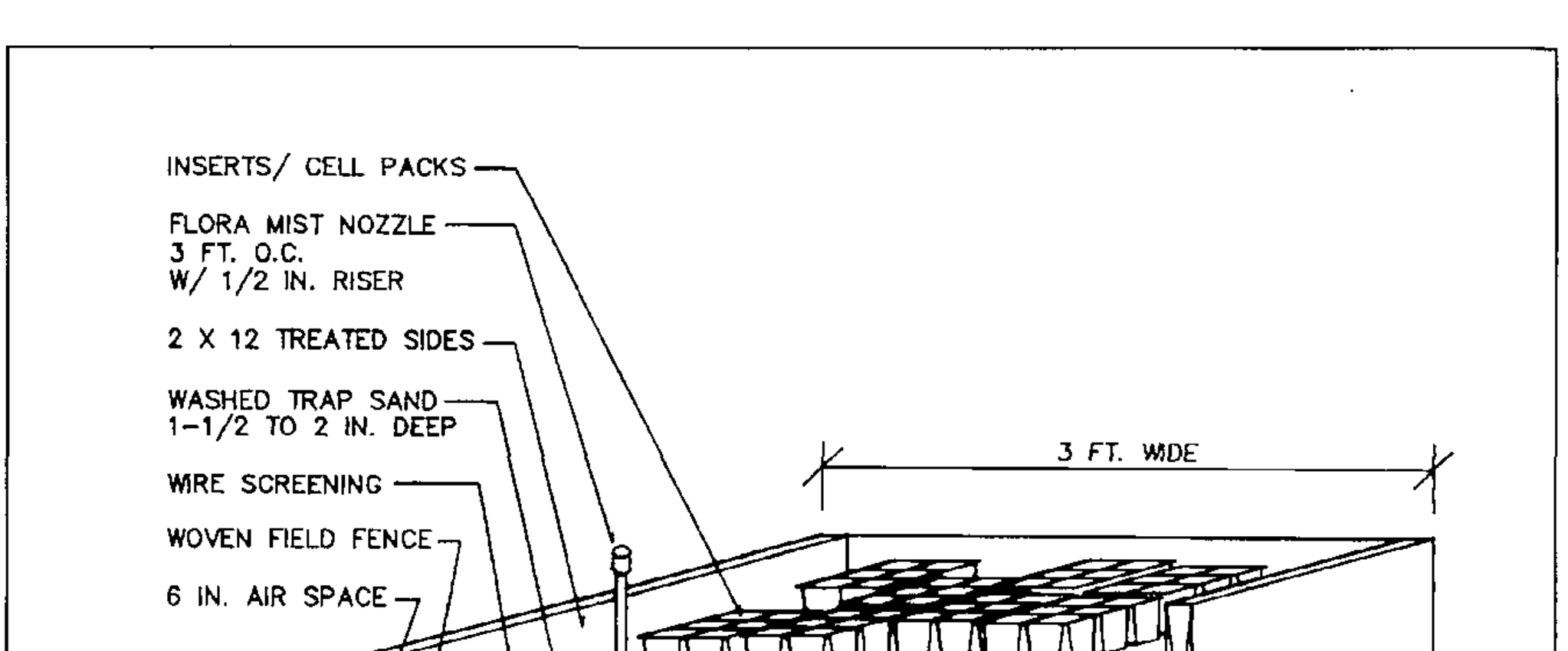

Figure 1. Propagation bed and bottom heat system at Hawksridge Farms.

top of the woven field fence. The screen wire is stapled to the 5.1 cm × 20 cm (2 in. × 8 in.) boards. A 3.8 cm (1.5 in.) layer of washed trap sand is then spread on top of the screen wire. The air space between the gravel and the sand provides for more even heat throughout the bed. A detailed drawing of bed construction is found in Figure 1.

The boiler we use is a Crown 225,000 BTU Input that is fueled by propane. We try to maintain soil temperature around 18C (65F). Air temperature is maintained around 4C (40F) by a 175,000 BTU Modine heater.

Inserts, cell packs, or whatever type of container that is used are then placed on top of the sand. The size container that is used will determine the number of cuttings a house will hold. For example, if we use 60s-cell packs for an entire house, we can stick approximately 63,000 cuttings. Propagation media will then be shoveled into the containers and smoothed. Our mix for winter cuttings consist of 2 bales of peat moss [0.23 m^3 (8 ft^3)] and 12 bags of perlite [109 kg (240 lb)] (2 : 5, v/v) plus 6.4 kg (14 lb) of lime and 1.1 kg (2.5 lb) of Micro Max.

Mist is regulated by a 5-min timer that is controlled by a 24-h clock. The amount of mist varies day to day according to the weather. Once plants are rooted, mist is no longer used and plants are watered overhead by spinner nozzles. Plants stay in the propagation houses until they are to be potted in the field, a period of 6 to 9 months.

COST OF PROPAGATION SYSTEM CONSTRUCTION

Cost of this system excluding labor and greenhouse frame is:

1) Mist	$478
2) Lumber	$5131
3) Wire and screen	$1900
4) Boiler	$4170
TOTAL	$11,679

The total amount of $11,679 may seem high, but in building this third house, we used a better boiler, lumber, wire, and screen. Our first house was in service for 10 years with less expensive components, so we hope to get at least 15 years from this house.

As stated earlier, we feel it is to our advantage to use this system with certain types of plants such as *Cupressus arizonica* 'Blue Ice' [syn. *C. arizonica* var. *glabra* 'Blue Ice'] and 'Carolina Sapphire', *Cephalotaxus* cultivars, *Cryptomeria* cultivars, and upright junipers. Our percentage of rooted cuttings is approximately 85% to 90% on our needled evergreens.