writing. Additional adjustments in the design and function may become apparent with time.

Details of construction and priming the water-heating system are available from the author.

DEVELOPMENT OF A NATURAL VENT GREENHOUSE

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The development of a natural vent greenhouse is one in a series of developments aimed at more efficient plant propagation in my particular set of circumstances. Development of the concept of this house began in 1977.

Up until then, my nursery's efforts were almost exclusively to produce citrus in several sizes for dooryard sales through retail outlets. Planned expansion of woody ornamental production on 25 acres mandated the development of efficient buildings and production tools for the specific purpose of propagation. At this time (1977) most woody ornamental propagation in Florida was done in open sun under mist using a peat bed or rose pots with a peat:perlite medium.

As recently as 1970, there was opposition to including a propagation unit inside greenhouses at Florida vocational schools as county commissioners felt putting a propagation unit inside a greenhouse was a huge waste. However, seeing production problems throughout the state convinced me that efficient climate control was essential with woody ornaments even in Florida's subtropical climate.

The style of the buildings that I saw the pepper growers build in Webster, Florida, appeared to be efficient. A very innovative structure seen at Wetherwood Nursery in Dover, Florida proved the desirability and versatility of the new innovation of double poly covering. The development of double poly covering has made it possible to construct a very inexpensive, but effective propagation structure. Ventilation comes in through openings the length of the house on the side and out through gable ends.

Nine wood-frame structures were eventually constructed in 1978–79 using this basic plant at a cost of approximately $1,500 per building. The amount seemed reasonable in light of the fact that we

could turn out a crop of 60,000 quality finished liners every three to four months. After several crops we found that one of the shortcomings of the wood frame was the continuing sanitation problem. These houses withstood two hurricanes, but effective as the houses were, opening and closing the sides and ends was a heavy labor cost. We eventually changed construction, as explained later.

Benches and trays were the next considerations. Several alternatives were evaluated, but the necessity of having cool conditions for liners in the summer and warm conditions in winter, made placing the benches on the floor seem desirable.

Selection of a tray that could be filled and handled efficiently while producing a quality liner that could be held for extended periods of time proved to be a challenge. Tests on every available tray on the market yielded information but there was not one that seemed suitable for use under our conditions. We use a spinner sprinkler system instead of mist heads as we cannot afford the time and labor cost of unclogging fog nozzles. We experienced drainage problems with every tray we tested.

The end result was development of our own tray. It is designed for efficient filling and handling and has a shape conducive to desirable root development. There is a large bottom hole for air pruning and drainage. The root development was so dramatic that a single eight-week gardenia liner planted out in the old style egg can had formed such an extensive root system that the entire plant, pot and all, could be picked up by the plant after only six weeks in the container.

Since 1978, production of woody ornamental liners has varied from one to three million per year. In 1984, we developed a new line of six trays that were needed for our increased nursery production. The new style tray is designed so that liners can be held for an extended time without root damage.

Review of the total propagation program showed that we had an effective, efficient program but that new developments in houses and benches were necessary to improve quality further, lessen labor demands, and reduce sanitation problems. Employees damaged the floor benches by walking on them, and sanitation problems with wooden benches and rusty wire caused losses of valuable crops.

The development of a portable bench eliminated wood benches and rusty wire and gave us flexibility in the propagation process. Trays are always out of contact with the ground, efficient drainage is assured, and air-pruning promotes branched feeder root systems. The unit can be moved out of the propagation house anytime after rooting and placed on plastic, ground cover, or other surface with the same continuing, dry sanitary support. This reduces costs dramatically and allows utilization of space more efficiently. Houses can be emptied, sanitized, and refilled as needed.

A new metal frame house of 16,000 ft.^{2} with cooling pads, exhaust fans, double-poly covering, and rolling benches was constructed. It proved to be effective, but disappointing. It had less sanitation problems, but the maintenance of the cooling pads and exhaust shutter fans was expensive. If anything went wrong, the whole crop was endangered unless the problem was discovered and corrected at once.

A greenhouse using natural ventilation was constructed in 1987. It was designed to take advantage of the movement of rising warm air out of a ridge vent while drawing cooler air in through side openings.

The essential elements of the ventilation in the natural vent greenhouse are:

1. An aperture at the ridge, the full length of the roof and
2. An aperture the full length of the side or sides of the house.

These apertures are opened and closed, utilizing a polytube inflated with a 1/20 h.p. fan. For the prototype, simple PVC ball valves are used to control movement of air to each tube. The apertures may be fully or partially closed or opened depending on temperature requirements. Regulating the size of the opening regulates air flow and effectively controls temperature.

We anticipate adding programmable controls in the future to eliminate labor costs, minimize spread of temperature, and maximize heat retention in winter.

Although our facilities are designed so that we could use fog, we are content with our propagation program at this point and will probably not add a fog system. The combination of our new trays, the portable bench, and the naturally vented greenhouse, we feel, gives us a near ideal facility for woody ornamental propagation at our location. In addition, our system could easily be adapted to grow numerous other crops.