tempting to improve our techniques. In closing, I would like again to emphasize the importance of keeping records. It is only on the basis of written information that a logical procedure can be developed.

PROPAGATION IN UNHEATED HOUSES

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Until a few years ago, we though it was necessary to heat every house throughout the cold season. Each house was equipped with a butane-burning Modine heater set at 15.5°C (60°F). Our heating bill during the period of October through March was over $6000 for heating seven houses, a typical expense for our area. With the spiraling cost of operation and equipment, we are always searching for ways to cut costs.

During the fuel shortage of 1976 we decided we must find a method that would produce a crop without requiring so much fuel. Since then we have experimented with houses closed at each end, with houses open at each end, with different soil mixes and with other variations in technique. Although we are not certain exactly why, I can tell you about the methods that have worked for Cottage Hill and perhaps you can adapt these methods to your own operation.

Over the last few years we have developed a heating method for our propagation that has saved us an increasing amount each winter. While this method does not eliminate heat entirely, it cuts our winter gas expense to a fraction of our original cost.

Success in propagation depends on a few basic rules. Cuttings must be taken from disease-free stock. Cleanliness throughout the operation is essential. And certainly we must keep accurate records for both information and comparison with future crops.

At Cottage Hill we take cuttings from young, healthy and vigorous container grown plants. The young plants yield a cutting that will root within a shorter period than a cutting taken from old overgrown stock. Secondly, a continuous spray program keeps the stock disease-free. And finally, our own records are constantly used as a guideline for improving previous methods.

In the past our cuttings were made during the early part of

the summer and were often kept in the propagating houses until the following spring. Today we take cuttings the year round, which allows us to produce a crop every six months.

All our propagation is done in Quonset-type houses covered with single layer 6 mil poly and 50% Saran shadecloth. The houses are 100 feet by 32 feet. We stick cutting directly in either 2¼ or 3¼ inch pot containers. Most of the Glenn Dale and Kurume azaleas are stuck in 2¼ inch pots, as are *Ilex crenata* and most other upright small-leaved plants. *Ilex cornuta*, *Photinia*, *Camellia* and other broad-leaved plants are grown in 3¼ inch pots. Empty pots are set in flats placed on a wagon and filled with soil. The filled flats are then put in the greenhouse on either black poly or clam shells. After pots are placed, a herbicide, either Ronstar or Lasso[1], is broadcast at the rate of 1½ pounds per 2000 square feet. Misting is done prior to sticking the cuttings. Each house is equipped with a timer set at 15 seconds per ½ hour. We stick the cuttings when the soil has reached the right moisture level. We use the same soil mix for all our plants (azaleas, conifers and broad-leaved evergreens). The medium consists of 4:3:1 pine bark, shavings and sand, modified with Scott's Pro-Gro 24-9-9 plus minor elements, iron sulphate and uramite. We add 5 pounds dolomite lime and 4 pounds clacium carbonate per cubic yard. The physical properties of this medium gives us the aeration and drainage required to grow a quality plant within a shorter period. At Cottage Hill, we use the same mix throughout the growing cycle. The pH at potting time is around 6.8 and usually levels off between 5.8 and 6.2.

Cuttings taken in the field are of young wood about 3 inches long. In most instances we do not strip the bottom leaves or use a rooting hormone. As a disease deterrant we soak the cuttings in a solution of Polyram[2] before sticking. We soak the entire cutting for 30 minutes, then stick immediately.

Our first experiment to conserve heat while propagating was on a house of azalea cuttings ('Copperman', a Glenn Dale hybrid; *R. indicum*, (Syn.: *R. macracanthum*) 'Red Ruffles'; 'Gumpo'; and four other cultivars of *R. indicum*) taken on October 10. By November 20 a good rooting action could be observed on nearly all cultivars. The lowest temperature recorded during that period was in the upper 30's F. On December 15 the plants were given a liquid feeding of 20-20-20 water soluble fertilizer at 200 ppm. Later, on January 4, a dry feeding of 25-10-10 was applied at the rate of 1½ pounds per 100 square feet. On

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[1] Scotts ProGrow Ornamental Herbicide 1 (Ronstar 4%), oxadiazon, O.M. Scott Co.; Lasso, alachlor, Monsanto.

[2] Polyram-Comb; metiram, Niagra Chemical Company

January 8 an open flame heater was installed. A 20 gallon container of water was placed on top to create a high humidity in the house, which raised the temperature a few degrees. At this time we applied the fungicide Daconil[3] as a precautionary measure and repeated this every two to three weeks. Between January 8 and 20 the lowest outside temperature recorded was −7°C (19°F) and, although the plants showed active growth, no damage was recorded. The first week of February the herbicide Ronstar was applied at 1½ pounds per 2000 square feet. This resulted in a slight tip burn, probably caused by the excessive moisture on the plants at the time of application. In the long run this was beneficial, since the plants showed many breaks several weeks later. However, I would hesitate to recommend this method of pinching. By April 15 the plants were ready for transplanting. These transplants produced salable plants by the following fall and spring. We considered this experiment successful enough that we have gradually converted our other houses to this method.

One house stuck with *Ilex* species in August 1, 1978, went through the winter without any damage, although it was one of the worst winters in our area. Out of the 36,000 cuttings stuck, 100 per cent were transplanted the following spring.

On October 1, 1978, 26,000 *Ilex vomitoria,* 16,000 *Ilex vomitoria* 'Pendula' and 22,000 *Ilex crenata* 'Helleri' were stuck. Again, rooting was almost 100 percent. *Ilex vomitoria* 'Pendula' did show some losses.

The final and most crucial test was a house of camellias. On November 7, 1978, 40,000 cuttings of 25 *Camellia japonica* and *Camellia sasanqua* cultivars were taken and placed in a house without heat. We considered the results to be phenomenal. Over 90 percent of the cuttings came through the winter and developed into suitable liners even though we experienced severe losses in our established container plants. We feel our success is related to the almost 100 percent humidity. The air is heavy with moisture. We have found that soil may even freeze in containers at the perimeter of the houses, yet we have no root or top damage.

What was gained by taking these chances? Our heating bill for that year for 13 houses, plus an office, was $236, a saving of well over $6,000 in spite of rising fuel prices.

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[3] Daconil or Bravo, chlorothalonil, Diamond Shamrock