

3,762 gallons for a cost of \$946.90 per heating season. To cut heating costs in the fall of 1975, it was converted to natural gas and individual records were no longer maintained. The house has a capacity of 204,600 rooted cuttings. Based on the 1972 through 1975 average cost of propane, we rooted 200 cuttings for one penny. Converted to natural gas at our present rate of 32¢ per 100 cubic feet, the cost to heat the house is \$1,203.84 per year. Using present rates we could root 166 cuttings for one penny. Natural gas costs 5 times what it did in 1972.

The house is going into the eighth heating season and we have had only two leaks in the plastic pipe. We did have some difficulty isolating one of the leaks and if we were going to install the system again we would put valves on each heating loop.

We have had no problems with expansion of the pipe; however, we would put expansion loops in a new house. When we start the house each fall the pipe moves as much as 18 inches. For this reason we cool the house only once each year.

From our experience, if we were to build the structure again, we would follow the same plan with these modifications:

- 1) Install a valve at the inlet and the outlet of each heating loop to simplify finding leaks.
- 2) Install swing joints for expansion within each heating loop to cut down on movement of the heating pipes.

We have used double poly on the house since 1975, but we are not convinced it is a worthwhile investment. Early in the morning during the coldest days of winter, it is not uncommon to see frost on the cuttings while the root temperature is 68 to 70°F.

With the flats of evergreens covering the floor of the house, we find this house cheaper to heat than the same size above ground house with individual unit heaters at each end. It has lived up to our expectations for rooting cuttings.

LITERATURE CITED

1. Kyle, J.H. 1973 New propagation house using plastic pipe bottom heat. *Proc. Inter. Plant Prop. Soc.* 23:247-250.

TECHNIQUES TO REDUCE ENERGY USE

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In a paper presented at the 1978 IPPS meeting I described our pithouse propagation facility (1). The building is H-shaped

and constructed below ground which I feel helps to moderate the temperature. Additional energy savings are obtained by using 3 layers of plastic on the roof.

Today I would like to discuss the economics of heating our pithouse. There is a choice of 5 energy sources: wood, coal, oil, gas, or electricity. Natural gas, if available, would be more economical than oil at this time; however, we don't know what the price will be in the future. Wood needs a lot of attention, especially during the night, so I do not find that practical for my propagation house.

Coal is for me the most practical heat for a propagation house. I use an upright burner, brick lined of cast iron, which holds 100 lbs of coal. I use coal in combination with electric cables in the beds. I bought coal in bulk at \$72.00 a ton. The price expressed in energy units is $\frac{1}{3}$ the price of oil. I would suggest heating the propagation house with coal to about 65°F and let electric cables in the beds bring the temperature up to the desired range (in my case 73°F). I still have my oil heat as a back up, since that was originally installed.

Having a propagation house in the ground and switching from oil heat to a combination of coal and electric cables is saving me up to 75% in heating cost.

LITERATURE CITED

1. Knuttel, A.I. 1978, Oil savings in pithouse rooting of rhododendron and laurel cuttings. *Proc. Inter. Plant Prop. Soc.* 28:516-517.

PETER VERMEULEN: Question for Bill Devine. Could you describe your climatic conditions for us? I am particularly interested in temperature.

BILL DEVINE: In 1976 we had the ground freeze to 3 feet. The soil which was covered with 8 inches of straw between 2 plastic sheets did not freeze.

PETER VERMEULEN: Any rodent problems.

BILL DEVINE: Yes, you have to use poison.

PETER ORUM: Question for Adrian Knuttel. Why not use the coal to heat water? We find that it costs about 5 times as much to use electric heat as hot water heat.

ADRIAN KNUTTEL: Yes, you are right. However, you must remember that we are only raising the temperature 5 to 10°F with the electric cables in the beds. The electricity is only on for a very short time. This is a very inexpensive method for heating when you consider that it probably would cost \$2,000 to buy a coal hot water boiler.