FREE HEAT OR DESIGNING FOR LOWER COST HEATING PROGRAMS

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My freshman economics teacher said, "There is no such thing as a free lunch." That also applies to the cost of heating propagation houses. My emphasis is: How can we decrease the cost of fossil fuel? Oil and gas and heat-making stoves were relatively cheap 10 years ago and we learned to enjoy their great convenience. Sometimes the cost was so low that we tried to heat up all outdoors. Some of you probably own a stainless steel infra-red heater that was advertised as keeping the frost off an acre of ground. But the cost of oil, gas, electricity, heaters and fin pipe have all gone up.

There are other heat sources that we ought to look into. One is earth heat — the heat in the soil — 6 — 10 — 100 ft deep. Heat pumps in our homes use earth heat. I believe that our poly sturctures should be designed as an "A" shape with perhaps a 30° rafter angle right down to the soil. You may not store many plants in that narrow angle, but your structure at night is picking up earth heat from that covered space. It also "slips" the wind better. So one of the changes that I suggest to combat cold weather is to change the shape of our buildings. I believe the day is gone when we build more hot bed sash. That was a small 2 ft high × 6 ft wide greenhouse. It is not very good for holding night heat. And besides, the labor stood outside in the sun, wind or snow.

In addition to earth heat, we ought to look at solar heat. Another change that some nurserymen are making is to move his business to the Sun Belt. TIME magazine says that is where many of your customers are migrating. If you are closer to the sun or at least in the South, you still have to learn how to use and conserve solar energy. Sun energy is radiant energy. We have to look at incoming radiation on a bright day and outgoing radiation all night long.

In our research in Georgia, we have been comparing different structures for several years. One thing I have observed is that a large cubic volume structure is beneficial. It encloses a large body of air which has some good temperature characteristics.

I know a man who built his poly houses with 6 ft gutter height. The next year he built another greenhouse with 8 ft gutter height (more headroom — more heat holding — more air circulation). The next year he built 10 ft and the next year 13 ft gutter height. He could drive his van into the greenhouse to load it. On some hot days, even with exhaust fans, the hot air was several feet over the growing plants.

Let me tell you of my 2 × 4 model structure. Everyone will build a different design but I am not giving you a blueprint. I am looking at some heating characteristics.

In my model, there is a 20 ft post in the center and 40 ft rafters and several other posts on each side. That makes about a 30° roof angle with 70 ft of ground covered. I believe that is a good angle for snow, and it also slips wind which is a very common cause of greenhouse failure.

When I cover this frame with a single layer 4 mil clear poly, I record a high day heat and a relatively high heat loss at night. Remember, I am trying to decrease the fossil fuel oil bill. If I cover the frame with a double layer of poly, I can conserve a lot of night heat loss. Some of you have reported fuel savings of up to 30% from this simple step. In Georgia we have a lot of winter sunshine, so I spray the outside layer of film with white latex paint until a light meter tells me that 8000 ft-c at noon has been cut to 4000 ft-c. I add 50% shade to the poly cover. These two improvements over single poly are very inexpensive and they conserve a great deal of heat at night.

The next inexpensive step in utilizing solar heat has been called "fire water". Water has a high specific heat. It is slow to heat up during the day, thus tending to keep the greenhouse cooler at noon. It is slow to cool off at night, thus adding heat to the greenhouse air. In an effort to keep the cost down, we have not used big central storage tanks, coils and pumps. We have used common 50 gal drums. It is even better if they are painted black. They are big, cheap, long lasting, have a good amount of surface area for heat exchange and no moving parts. We place these barrels around the inside periphery of the greenhouse frame at about 6 ft centers. They are 12 inches below the sloped plastic roof and do not use up much floor space, The barrels are located at the coldest part of the structure. As the air at night cools, it migrates down the inside of the plastic ceiling and passes by the barrels of water which store the solar heat. The water warms the air as it flows by. With these simple heat conserving measures and no fossil fuel it is easy to maintain 33°F at plant height at 5 am when it is 15°F outside. When the water begins to freeze, the latent heat of fusion is released. In the process, it absorbs a lot of cold and gives off low-cost heat. On a night when it was -2.0°F outside, it was 25°F inside with ice forming in the barrels. With our zero fossil fuel program, we are not trying to keep 65°F inside. Many woody plants and rooted cuttings will withstand air of 25° better than −2°F. This can turn a hard winter into a mild winter. Roots will grow.

I believe the system would work better if twice as many barrels are used. Consider that Cleveland, Rutgers and Long Island have relatively mild winter climates because of their proximity to large bodies of water. This year I intend to stack one barrel on another near the center of the house to increase the night heating ability.

Another heat saver is to line the inside of the north side of your greenhouse with some insulating material. I obtained some 1/2 inch styrofoam which is a very effective radiation barrier and placed it on the north side.

The last measure that I will suggest to lower the heat bill is to pull a black cloth at night. Mum growers have found that common black cloth or black plastic can make a 15°F difference — say between 50° and 35°F. I suggest it last because it is a relatively expensive installation, especially if it is time-clock operated. I believe at the present cost of fuel it may be cheaper to run the modine heater before you install an inside black plastic barrier for heat conservation at night. But when the price of fossil fuel goes up again you might consider pulling a black cover over your water barrels and over your crop every evening at 5 pm, especially on severe nights. This heat conserver could be removed at 9 am on a winter morning.

Horticultural technology is changing. I am convinced that these heat conservers will add a few pennies to your profit picture. What can you do? Double-layer poly, paint shading, water barrels, north side insulation, black cloth at night.

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A SOLAR POND FOR HEATING GREENHOUSES[1]

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Greenhouses are heated almost entirely by solar energy by day and fossil fuel by night. It is the fossil fuel requirement at night that is becoming or has become prohibitively costly. The greenhouse almost always accumulates surplus heat during daylight hours — even in Ohio mid-winters. A system that collects solar energy and stores greenhouse surplus heat for nighttime use could be very beneficial. Therefore, a solar pond is being studied as a solar collector and potential storage system along with the appropriate equipment to move heat to and from the greenhouse.

Natural solar ponds were first discovered in the early 1900's in Hungary (2). Temperatures up to 80°C (176°F) have been recorded. It is theorized that such ponds are fed by saltwater springs while fresh rainwater periodically flushes off the surface. The result is a stable pond of solar heated brine at the bottom of which is too dense to circulate to the surface and cool. More recently, researchers believe that a warm lake in Antarctica is a solar pond rather than a previously assumed hot spring lake (1). Tabor (5) has probably done some of the most extensive work to date to make the solar pond economically useful for power generation in Israel. Israel is in a high radiation area and the Dead Sea is a good brine source. Tabor was able to achieve small pond temperatures up to 90°C (194°F), but had numerous technical problems with large ponds. One large pond in a marsh area was destroyed by mud bulges and gas bubbles being generated as the pond warmed. A plastic liner was installed, but the same bubble action lifted the liner in various areas and caused severe mixing of the pond. There were also tedious problems in establishing the pond concentration