FRIDAY AFTERNOON SESSION

VICE-PRESIDENT BRIGGS: For our final technical session of the meeting we will have Joe Klupenger of the Klupenger Nursery, Aurora, Oregon, as moderator. Joe:

MODERATOR KLUPENGER: Our first speaker this session is Production Manager of Greenleaf Nursery, Park Hill, Oklahoma. Mr. Austin Kenyon is going to speak to us on "Winter Storage of Container Plants". Mr. Kenyon:

WINTER STORAGE OF CONTAINER PLANTS

AUSTIN KENYON
Greenleaf Nursery Co.
Park Hill, Oklahoma

Our nursery has been providing winter protection for container-grown broadleaf evergreens since the winter of 1963. This was necessitated by severe damage and heavy losses during each of the three previous winters.

We are located in northeastern Oklahoma in the Cookson Hills approximately 50 miles west of Ft. Smith, Arkansas. The average minimum temperature is 5° to 10° F. below zero. However, overwintering in our area is further complicated by rapidly fluctuating temperatures, with highs in the 70° F. range sometimes being only 24 to 36 hours ahead of the extreme low temperatures. Therefore, most broadleaf evergreens grown in containers, such as pyracantha, euonymus, holly and the soft varieties of deciduous shrubs are subject to varying degrees of winter damage. We felt that polyethylene-covered houses offered the most promising solution, but several criteria had to be considered:

1. The houses had to be low in cost.
2. They had to be able to hold snow loads of 6 to 12 inches.
3. They had to withstand winds in excess of 60 mph.
4. They had to be easily erected and dismantled as we intended to put up the houses in the fall and take them down in the spring.
5. They had to do an adequate job of protecting the plants.

The structures I am going to describe are being prepared for use for their sixth winter. We decided on A-frame construction because of its relative strength and simplicity. By making individual A-frame bows and joining any number of bows with stringers, a house of any desired length can be erected. The A-frame bow is constructed from two 2 x 6's — 19½′ long, with a 12′, 2 x 4 cross brace, and gussets of ⅜″ plywood, resulting in a bow 33′ wide, 11′ high, each leg making an angle of 31 degrees with the ground. The bows are spaced

8′ apart with 2 x 4 stringers 16′ long, nailed to the bottom, middle and top. Diagonal braces are put at each end and, in the case of a long house (200′ or more), braces are put in the middle. Metal stakes constructed of 1″ structural pipe are driven into the ground to hold the house down. The ends are then covered and padded and the stringers inspected and rasped down if necessary in order to prevent tearing the plastic sheet.

The house is now ready to cover. However, in practice, we will bunch up the plants first and erect the house over the plants. The containers are stacked three high if necessary, so that a block of spaced plants 100′ wide will fit into the 30′ useable width of the house and allow an 18″ aisle down the middle and a cross aisle every 40 feet. The stacking of the plants is very important. On the bottom layer the plants are put can to can. The second layer is can to can in one direction, but spaced the size of a can in the other direction. The top layer is spaced all the way. The result is, that for each 4 cans on the bottom layer, there are 2 cans on the second layer, and 1 can on the top layer. In the case of 1-gallon cans, this is 7 plants per square foot.

After the plants are stacked, the house is erected over them. The plastic sheets are ordered to fit the houses plus about 10% extra length to allow for adding a couple of bows if necessary. and to allow for possible slight errors on the part of the plastic manufacturer in cutting, the sheet. The sheets are all 40′ wide. I don't know of any company manufacturing sheets wider than 40 feet. Our houses vary in length up to 500 feet.

When the house is completely ready to cover, the plastic is rolled out beside the house and carried over and draped in place. The sheet is then nailed down with lath at one end and stretched to the other end.

It is important that the weather be suitable. It is virtually impossible to handle these large plastic sheets in winds over 15 mph; a completely calm day is very desirable and makes the job much easier. The temperature should be 40° F. or above on a clear day, and 60° F. or above on a cloudy day; otherwise it is impossible to obtain the necessary stretch on the plastic.

The plastic is stretched and nailed to the middle stringer by a crew of 5 or 6 men on each side of the house pulling against each other. Then the plastic is stretched and nailed to the bottom. The plastic should be drum tight when the job is completed in order to withstand the winter winds. The plastic is then nailed over every other bow in order to break it up into small, repairable sections. The house is then sealed along the bottom with sawdust. Shading material is applied to the houses as desired. The doors are closed any time the temperature is expected to go below 32° F. In the spring, cigar-shaped holes can be cut in the plastic above the middle stringer to improve ventilation.

We will evaluate these overwintering houses with regard to the criteria outlined earlier. First we said the houses had to be low in cost. Here is a cost breakdown on one A-frame bow:

40 feet of 2 x 6 @ 10c ft.	$4.00
12 feet of 2 x 4 @ 6c ft.	0.72
40 feet of 2 x 4 @ 6c ft.	2.40
two metal stakes 2 feet long plus 1 foot of strap metal, plus labor	1.00
3 sq. ft. of 3/8″ plywood @ 13c sq. ft.	0.39
4-mil polyethylene, 8′ x 40′ @ 0.7c sq. ft.	2.24
estimated labor to build bow	0.50
estimated labor to haul bows, erect buildings and cover with plastic	2.00
50 feet of lath @ 31.80 bundle	0.45
nails	0.15
Total for 240 sq. ft. usable space	$13.53

Thus the initial cost per sq. ft. is 5.8 cents. However, if we assume that the bows will last 4 years, the lath 3 years, the stakes 10 years, and that the labor to disassemble the houses is the same as that to erect it, we came up with a prorated cost of 3.5 cents per square foot per year. When it is considered that it is possible to stack as many as 7 one-gallon plants per square foot, the cost can be as low as ½ cent per one-gallon plant, which we feel is certainly reasonable.

Next, we said the structures must hold snow loads of 6 to 12 inches. The heaviest snow load we have had while using these houses, was 6 to 8 inches but this didn't seem to be very close to the structural limit.

The houses have gone through winds in excess of 60 mph and the only damage was a few iron stakes pulling loose and a few rips in the plastic which were easily repaired. If stronger winds were expected it would be necessary to use more iron stakes, or to use an entirely different means of anchoring the houses to the ground. It would also be necessary to lath the plastic to every bow rather than every other bow.

Next, we said that the houses must be easily erected and dismantled. It takes a 6-man crew approximately 4 hours to erect a 300′ house, if the materials are all close by. It takes 20 men about 2 hours to cover the same house.

The last criteria was that the houses had to do an adequate job of protecting the plants. I can say with no reservations, that ours do an excellent job. Winter damage is practically a thing of the past for us. On a cold night the temperature inside is usually 20 to 30 degrees above the outside temperature. In our climate the soil ball of the plants never freezes more than 1″ deep. Here are two exerpts from temperature records I kept the first winter we used the houses:

Dec. 22, 1963 — The outside temperature has not been above freezing for several days. It snowed approximately 3″ last night; at 5:30 P.M. the temperature outside was 14° F, inside it was 32° F. The low outside during the night was 7° F below zero; inside the low was 26° F.

Jan. 13, 1964 — The low outside was 4° F; inside 26°F. High temperature outside was 30° F; inside it was 56° F.

It is also important to note that the foliage color of most plants overwintered inside is much better than those left outside. This is certainly an important spring sales consideration. However, unless the houses are shaded, the plants inside will break dormancy 2 to 3 weeks ahead of plants left outside. Also, it is necessary to water the plants inside once or twice a week, or even more often during a warm spell. We use #20 Rainbird sprinklers, equipped with a baffle, spaced 20′ apart down the center of the house. Rodent damage in the houses can be quite severe, and it is necessary to maintain bait stations. The warm temperatures and high humidity in the houses are very conducive to insect and ddisease development, so we spray every two weeks with Captan, and every four weeks with Sevin.

During the winter of 1964 we decided to experiment with white opaque plastic. We used two overwintering houses of the same width and length, located side by side, one covered with clear plastic and one covered with white plastic giving 40% light transmission. A maximum—minimum recording thermometer was placed in each house at identical locations in order to compare inside air temperatures. Also, a continuous recording thermograph was placed in each house with the probe buried 6″ deep in a 5-gallon can to compare soil temperatures. Finally, a contintuous recording thermograph was placed outside to record outside temperatures. Due to the favorable results with white plastic from this experiment, the following year we covered approximately ⅓ of our overwintering houses with white plastic. In comparing clear plastic with white plastic, we have come to the following conclusions:

1. Night air temperature is approximately the same in both clear and white houses. We had expected the white to be warmer at night due to reduced heat radiation. However, on a cold night a heavy layer of frost forms on the inside of the clear plastic, resulting in heat transmission approximately equivalent to the white plastic. Also the frost layer, from ⅛″ to ¼″ thick, has some insulation value.
2. The daytime air temperatures are much higher in the clear plastic houses, approximately 15° to 20°F difference. The temperature in the white houses is about the same as the outside temperature during the day.
3. The soil temperature is quite uniform in the white houses while that in the clear houses fluctuates somewhat, being higher on the average.
4. Water requirements are much less in the white

houses, the plants needing water only about every two weeks.

5. The plants stay dormant 2 to 3 weeks longer in the white houses, breaking dormancy about the same time as plants left outside.
6. Foliage color is a little better on plants in the white houses.
7. The clear plastic is much stronger than the white plastic. The white plastic on all the houses covered for the winter of 1964 failed before March 15, 1965. This was a serious problem and forced us to abandon the use of white plastic. However, it is possible we used an inferior grade of opaque plastic in our tests.

MODERATOR KLUPENGER: Our next speaker is Mr. Henry Mollgaard, Mollgaard Floral Co., Snohomish, Washington who will speak to us on mechanization of propagation structures. Mr. Mollgaard:

MECHANIZED GLASS STRUCTURES

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In a structure where three to six crops of potted plants are being transported during a year, provision for moving plants quickly and easily is essential. One effective means of operating a greenhouse efficiently is to mobilize equipment, using trucks, hand, and electric carts.

Easy accessibility around, to, and in the greenhouse must be provided for this equipment. Roads and walks inside and around the greenhouse should be either blacktop or concrete. The first is the least expensive, but gives some problems resulting from the weight of heavy equipment and from its softness during warm weather. The packing shed, too, should be completely surfaced.

Inside most new pot plant greenhouses the benches run crossways with a wide access aisle going the long way. As an example, a 37½ foot wide house may have a 5½ foot aisle and 32 foot long benches. The 5½ foot aisle provides enough space for an electric cart. Between the houses, a sheet of plastic is sometimes used to help control the heat. It can be raised for moving plants on the bench. Through this arrangement the plants are only carried as far as the center of the bench, which is 16 feet. A road wide enough to accommodate trucks crossways through the middle of the house will also cut down loading and unloading time. Of course, the gutters have to be high enough for the top of the truck to clear. The greenhouse doors used most often preferably should be electronic with the electrical carts and trucks equipped with devices to operate the doors. This will enable the driver to move swiftly about the greenhouses.