Ilex vomitoria, 1 g c, 10″	95%	63%	22% (dead tips)
Lagerstroemia Indica, 1 g c, 18″	90%	12%	0% (dead to soil)
Ligustrum lucidum, B & B, 24″	98%	79%	38%
Osmanthus fortunei, 1 g c, 24″	99%	88%	30%
Prunus laurocerasus, Schipka, B & B, 30″	95%	78%	47%
Pyracantha coccinea graberi 3 g c, 36″	91%	7%	0% (dead to soil)
Pyracantha coccinea, Lalandi, 3 g c 36″	96%	40%	5% defoliated
Pyracantha fruit still good on April 1, only under A frame			

MODERATOR TINGA: I hope I have successfully introduced the subject of overwintering for now we will have some experts who are going to give us the latest information. The first presentation will be by Richard Vanderbilt.

A LOW COST OVERWINTERING STRUCTURE

RICHARD T. VANDERBILT
The Conrad-Pyle Company
West Grove, Pennsylvania

The structure is a 14′ span polyethylene covered quonset house. The cost is about twelve cents a square foot in place and covered. We use it for winter protection of container grown material and to replace cold frames.

This structure evolved into a quonset house quite accidentally. We had considered, and to some extent, used the type of structures long since made famous by Bill Cunningham. Bill's designs are excellent and their only drawback is cost; about 50 to 60 cents a square foot. This cost can be sizeable when you need houses in multiples of miles. We have four miles of the 14′ houses up at present.

Up until three years ago we were using concrete reinforcing wire to support the polyethylene above our cans. It is a material that did do the job after a fashion. It is almost impossible to work around once put in place. Watering is very difficult. Pulling plants is impossible without tunneling in from the ends. Covering is a problem because of the many sharp edges that seem to always tear the polyethylene unless laboriously wrapped with burlap. To insure against collapsing, we have to use a center stake about every 4 feet. Finally when the time comes to remove the polyethylene, the whole unwieldy mess has to be picked up, carried out and stored some place.

Our first step to get away from this nightmare was to simply take a 10′ piece of ¾″ E.M.T. thin wall electrical conduit and bend it so it spanned six feet. The ends were drilled 4″ up, a nail inserted and bent over to act as a stop. We used a spacing of 5′ between hoops. They were then covered with 12′ wide polyethylene and the sides held down with soil. This worked beautifully. The hoops could remain in place summer and winter without interfering with cultural operations and the pulling of plants. Incidentally, these things can stand a seemingly unlimited amount of snow.

It was not without problems, however. Checking of plants was still a dirty, disagreeable job of pulling up polyethylene and sticking your head in. Watering while covered was not possible, but this seemed the best we could do at the time.

Soon we were forced to make a hasty move to a gully-ridden field next to a pond with a marvelous spring, because of a lack of water in our original container area. We were at least not cramped for space. We laid out our beds so that between each set of 5½′ beds and 3′ aisle we had a 12′ road. This was a direct imitation of Jack Hill's layout. It has worked out very well for all the operations that go on in the area.

We had planned to cover each of these 5½′ beds with the hoops that I had described earlier. It was at this time that I was struck with the idea of covering the two beds and the aisle with a single hoop.

We took two pieces of conduit and bent them to span the 14′ bed area. This cost no more than 2 single hoops and included an enclosed 3′ walk. Hoops were again placed on the same 5′ centers.

Our original 14′ hoop was made of ¾″ E.M.T. thin wall electrical conduit. This ¾″ pipe was adequate so long as the snow loads were equal on both sides of the house. Last Winter we had drifts of 8 to 10′ over the houses. Where the 8 to 10′ drift was one sided it had the distressing tendency to collapse the house! A 2 x 3″ center post hinged on a wire over every third hoop prevented this. We are now using 1″ E.M.T. thin wall electrical conduit, which is 88% stronger than the ¾″. This makes the center post no longer necessary. In no case has polyethylene failed at 5′ hoop centers due to snow load.

We bend 10′ sections of conduit into the desired curve using an electric pipe bender. We then insert a ¾ x 2½″ nipple into one section and hammer another section onto it. This joint is then acetylene welded. Each end of the hoop is inserted into 1¼″ water pipe, placed on 5′ centers. The 1¼″ pipe is 4′ long. It is driven into the ground 2′. The 2′ out of the ground adds to our sidewall height, which is a help in accomodating taller material.

The ends of the hoops are drilled 4″ up from the bottom and a nail inserted and bent over the 1¼″ pipe to prevent slipping.

We are now using a continuous 1 x 4″ wooden purlin attached on the underside of the hoops at the center of the house, for lateral stability. 1″ pipe straps secure it. The bottom sides have a nailer edge of 1 x 6″ cypress attached on the outside of the 1¼″ pipe with 1¼″ pipe straps.

Gables are only curtain walls as they support nothing. Wind braces are used on each side of both ends. We are using 1 x 6″ cypress angled in from about 4′ up on the first hoop tapering to the ground by the third hoop. Again, attached with pipe straps.

Length of the houses are at this point as long as we can make them. At first we figured making them 86′ long so 100′ of polyethylene would cover the top and two gables. Now we use continuous coverage overlaping the polyethylene 3 hoops. Our longest houses at present are 980′. This simplifies covering immensely.

Gables are constructed of a bottom board of 1 x 6″ cypress and an H frame stuck in the center, again of 1 x 6″. The polyethylene around the H is tacked down except on the bottom. This flap acts as a door.

Covering is done by unrolling the polyethylene which is 24′ wide, but center folded, down the road. It is simply walked through and over the house. We put it on with the fold inside out. We find we get much less tearing on the seam this way. One side is wrapped in 1″ x 2″ cypress and nailed. The other side is pulled tight and then nailed with another 1″ x 2″ cypress.

After covering, we lace the poly down. We use 2 mil polyethylene, 18″ wide, for this. This lacing prevents flapping to such a degree that there is no noise from polyethylene flapping in a 30 m.p.h. wind. The lacing is pulled over the top and attached at the bottom of alternate hoops. It is continuous. It is wrapped around a nail which is then bent over. Another nail is then bent over the head of the first nail to prevent the polyethylene from pulling out. Lacing must be fished over with a line from one side. This is done so that each hoop has a lacing fastened at its bottom. Since it is on a diagonal, the centers of the lacings form an X between each hoop.

Ten men are able to cover and secure 2,000 linial feet of quonset a day, or 28,000 sq. ft. of ground covered. Labor cost for covering is under half a cent a sq. ft.

The quonset is the only shape, I know, that fully exploits the fact that polyethylene is a plastic material. In other words, the stuff bends! A frames, trussed A framed roofs all are designed for a rigid material. To put polyethylene on any of these shapes requires that much nailing down be done on rafters if the stuff is going to stay put.

Costs per 14′ x 5′ Sections are:

MATERIALS

Poly — 60′ x 18″ = 90 sq. ft. — 2 mil. clear @ $3.00 per 1,000 sq. ft. (For Straping)	.27
Poly — 24′ x 5′ = 120 sq. ft. 4 mil. white @ $7.00 per 1,000 sq. ft.	.84
2 pieces 1″ E.M.T. thin wall electrical conduit	1.82
1 ¾″ x 2½″ nipple	.063
1 Weld	.20
2 pieces 1¼″ x 4′ water pipe for stakes	1.50
2 pieces 1¼″ pipe straps	.06
1 piece 1″ pipe strap	.02

1 piece 1″ x 4″ cypress purlin	.23
2 pieces 1″ x 6″ cypress bottom board	.70
2 pieces 1″ x 2″ cypress lath @ 3c	.30
Nails	.20
	$6.20

$6.20 for 14′ x 5′ = 70 sq. ft. or: $.088 a sq. ft.

COST OF GABLES

In addition, each house requires 2 gable ends and wind bracing which must be figured into the cost. The longer the house the cheaper per sq. ft. for gables.

2 pieces 1″ x 6″ x 8′	$1.12
1 piece 1″ x 6″ x 14′	.98
1 piece 1″ x 6″ x 3′	.21
2 — 1″ pipe straps	.04
Wind braces — 2 pieces 1″ x 6″ x 14′	1.96
4 pipe straps — 1″	.08
2 pipe straps — 1¼″	.06
	$4.45 x 2 = $8.90

	Cost per sq. ft. ground covered
100′ house add: $.0063 per sq. ft. for cost of gables and wind bracing:	$.0063
Conard-Pyle Construction Labor:	.023
Covering labor:	.005
Materials:	.088
Total:	$.1223 sq. ft.

KNOX HENRY: How is the heat built up in your plastic house?

DICK VANDERBILT: We use white polyethylene and it seems the highest you go is 15° F. above the outside temperature at any time. The material will remain perfectly dormant right until May.

VOICE: What is the thickness of the polyethylene?

DICK VANDERBILT: It is 4 mil. I would like to add one thing here. We are in the midst of putting in some Panama canals. Down the center aisle of the houses we unroll polyethylene, the cans hold it up on the edges, and we fill these things up with water. The water is not heated but as it cools the water releases 1 calorie of heat per gram of water per degree drop centrigrade until it reaches freezing at which time 1 gram of water releases 86 calories of heat. So you have a lot working for you for nothing. Last year we had four of those 86 foot houses and we put in 700 gallons of water. We had a potential of freezing of 700,000 B.T.U. In some cases where tender material was hurt, in the houses with the water, not only were the same type of plants alive but roots were growing 6 - 7 inches out of the bottom of the can. In the spring time you get the reverse effect. It takes 86 calories per gram of water to melt the ice. So you have a cold storage.

PETE VERMEULEN: Do you have any problem with the breakdown of the white plastic?

DICK VANDERBILT: We are the asbolute experts in the whole world on white polyethylene. The stuff is horrible. It doesn't break down, Pete, but when they put in the pigment nobody can predict what it will do. Last year the quality control was horrible. This year the quality is good.

MODERATOR TINGA: Next we have outdoor overwintering structures by Mr. Paul Bosley, which will be presented by his son, Richard.

THE LESS ELABORATE POLYETHYLENE STRUCTURE FOR WINTER PROTECTION

PAUL BOSLEY, SR.
Bosley Nurseries
Mentor, Ohio

Container grown material constitutes a major portion of our nursery growing; and as a result, our methods of protecting plant material was originally built around our need to protect these particular plants.

We have been using polyethylene almost since the beginning of polyethylene, and many of our methods are a continuing evolution or refinement of what we have done previously. However, the basic principle of polyethylene has not changed. It is a flexible covering that will allow the passing of gases but will not allow the passing of moisture through itself. It took us a number of years to realize some of the basic advantages of this method. For example, we know that many of the Evergreen Azaleas and Rhododendrons will lose their bloom buds when the temperature drops to around to 10 below zero; and yet when temperatures dropped to 25 degrees below zero, Azaleas underneath polyethylene protection, did not have their bloom buds damaged in the slightest. We know that there is a relationship between the damaging effects of low temperatures with and without wind, and we have come to the conclusion that the loss of the plant's cell moisture is a more damaging condition than mere low temperatures as such. We again come to the principle that polyethylene does not allow moisture to pass through its walls.

We have used many devices to attain results. The original and probably the simplest protective method is illustrated by this picture. You will see where concrete blocks are set on end and 2x4's are placed on top of them and the whole arrangement made so that a standard 4 foot roll of snow fencing will span either a bed or a group of containers. The snow fencing serves a double purpose. It immediately gives 50 per cent shade during the winter time when there are periods of