PLASTIC HOUSES FOR WINTER STORAGE AND PROPAGATION

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The old adage "there is nothing new under the sun" must, to quote another old adage, be "taken with a grain of salt". The fabulous fifties have had their impact on the nursery industry through the advent of plastic films. These are new. But it appears that many of the uses to which they have been put are refinements of old, old ideas. With the "old" as background we might review some of the uses of plastic houses, some of the problems and successes in the nursery field in order that it may stimulate a wider adoption of them for both propagation and winter storage.

L. H. Bailey (1) makes some interesting observations on the etymology of the word greenhouse and on the history of greenhouse construction and use. Dr. Bailey notes that the original meaning of the word was simply "a house in which to keep plants green during the winter." The plants were not expected to grow in these original "greenhouses" which may have started as a glass-walled portion of a dwelling. Ultimately separate structures evolved, made entirely of glass. European terminology referred to a house used for forcing or growing plants as "stove" houses, hot houses etc. In America common usage has come to limit the word "greenhouse" to a "glasshouse used for forcing plants, propagation, etc."

We have, however, come full circle and I should like to discuss the use of plastic houses as "greenhouses" in the original sense as well as consider some of their special attributes in the propagation program. The industry never got away from the use of cold frames, pits and other devices as means of preventing winter injury. And in recent years above-ground "cold frames" constructed of plastic have been tested extensively as winter protection for container-grown nursery stock. Concurrently the use of plastic houses for various phases of propagation has increased and some parties have used both heated and unheated plastic houses solely for winter storage.

Let us first consider the design, construction and some costs of suitable structures. The same factors apply whether the house is used for storage or propagation. Then we might discuss some specific uses of plastic houses, successes and failures and finally summarize with a series of slides.

Plastic houses had very early acceptance in climates such as exist in California. Heating is not the problem there that it is in more northerly latitudes. The concentration of industry there also favored widespread adoption of these relatively economical structures. The styles and variations have only been exceeded by the new models of automobiles, gable houses, shed-roofed houses, sawtoothed ranges and many other variations. Where snow was a problem the design was limited to a gable house. But in all these designs we have an illustration of the straight-jacket in which we restrict our minds when attempting something new. They are all "glasshouses" glazed with plastic, perhaps a little wider rafter spacing, but not much different. None really utilized one unique feature of plastic, the fact that it is available in large dimensions - 24' X 100', 28' X 100', 32' X 100'.

W. E. Cunningham of Cunningham Gardens capitalized on this attribute in the structure design that is now so familiar - the quonset shaped plastic house - available in various forms from most major greenhouse suppliers. This structure is simply a smooth metal frame with end-gables upon which a single sheet of plastic is spread. The plastic is fastened only at the perimeter to sideboards and the end gable. The design is particularly adaptable to covering with Saran screen at a minimum cost. The cost is less than for comparable area in cold frames and under current tax laws need not be capitalized.

Cost of materials for a typical 16' X 96' house of this style will probably not vary much from location to location, although used lumber, pipe or other parts may lower them somewhat. Labor costs will not be estimated for two reasons: first, pay scales vary widely, and second, labor efficiency (output per man per hour and slack seasons) will also vary.

Foundation pipes of 1" X 36" galvanized iron water pipe are driven in the ground or set in concrete at appropriate spacing (3') in two rows 16 feet apart and 96 feet long. These are driven to a level about 8 inches above grade and sideboards are attached with pipe strap. 24-foot bows made of 3/4 inch galvanized thin-wall electrical conduit are placed in these foundation pipes and fastened with bolts or cap screws. The conduit is joined with screw or clamp couplings and joints may be reinforced with 3/4 inch o.d. soft iron rod.

Early designs used 6 X 6 inch concrete reinforcing mesh to tie the bows into a unit and support the plastic. A later refinement at Cunninghams was the use of longitudinal members (purlins) of 3/4 inch conduit for this purpose. Fourteen-gauge galvanized wire is used for supporting the plastic between purlins.

The gable ends are constructed to fit and may be varied in details such as door location, ventilator openings, etc. Cunningham Gardens now glaze theirs to save on covering labor each year.

The final step is to install the plastic on a nearly windless day. The plastic must be rolled at least one turn around the furring strips to prevent tearing. W. E. Cunningham comments that "the secret of success is to have the plastic drum tight".

The materials cost for this house is about $400 and is broken down as follows:

1.	33 bows 25' long plus 7 purlins 96' long	$183.60
2.	Couplings, 129 at 18¢	23.22
3.	Galvanized pipe, 1", 10 lengths	56.00
4.	Soft iron rod	15.00
5.	Pipe strap, hardware, wire	18.00
6.	Filament tape	13.35
7.	Lumber at $200/M	80.00
	Sub total	$389.17
	Plastic, 2 layers and end gables	64.43
	Saran cover	125.00
		$578.60
	Options:	
	Heaters - 2 LP Gas + controls	400.00
	Ventilation, 36" fan + shutters, etc.	157.90
		$557.90

The job of a propagator begins with the starting of a new plant but doesn't end until the liner is sold or planted out. In many operations the propagator may also be concerned with growing. For the sake of simplicity in cost comparisons we will start with considerations of the unheated plastic house for storage of container-grown stock or liners and work backward to the young liner in a heated plastic house and finally to propagation in these structures.

If we take the construction figures just given and make certain assumptions we may arrive at some cost estimates for storage. Assuming $300 for labor plus $400 for materials, a total cost of $700 plus plastic is obtained. Amortizing this over five years the annual structural cost is $140 plus $64.50 for plastic; $204.50. Allowing a 2-foot aisle, 3,000 gallon cans may be stored in this structure at a cost of under 7¢ per can plus handling. Experience at Purdue University indicated that any conifers or broad-leaved evergreens could be decked two deep with good results and deciduous material could be stored three and four deep with safety. This practice would cut costs to less than 3.5% and 2.3¢ per can.

Comparisons of storage in a plastic house and storage under closed plastic frames as mentioned previously indicated a decided advantage of the former. The ability to inspect the stock, water and ventilate are probably responsible for lack of losses in the plastic house. Comparable species under frames suffered various degrees of damage in these tests. Items successfully stored at Lafayette included Junipers, Yews, Viburnum, Pyracantha, Abelia, Clematis, False Cypress, Kalmia, Azaleas, Leucothoe, Holly, and many more.

The largest storage operation in heated plastic houses with which I am familiar is at Cunningham Gardens. Here materials from summer and late propagation are stored with moderate heat; 50^{o} at 5 feet, about 40^{o} at plant levels. The plants attain dormancy but begin to grow in late winter and produce excellent stock for spring sales. We are indebted to Bill Cunningham for some cost figures in this operation. Two 75,000 BTU LP unit heaters supply this heat for about 16.9¢ per square foot per season. Comparable glasshouse heating costs for an oil-fired hot water system at 55° F cost 19.1¢ per sq.ft.

Plants stored successfully include Holly, Azalea, Baby's Breath (Bristol Fairy), Clematis, English Ivy, Vince "Bowles" and any late season propagations for which frame storage might be dangerous.

Bill calls attention to the versatility of these houses. In the summer they become shade houses.

Plastic houses are in widespread use in California in the propagation schedules for many crops. Some growers use them to grow their stock plants under greater environmental control than can be attained out-of-doors. With the use of mist propagation the author has been very successful in rooting many herbaceous and woody crops in an unheated plastic house in Los Angeles. Rooting was slower in the winter months but with 60 bottom heat a wide spectrum of crops could be handled: Azaleas, Hydrangeas, Euonymous, Carnation, Chrysanthemums, etc. Subtropical items did not root well in these conditions in winter but required heat.

In the midwest, nurserymen have used the Cunningham house for winter propagation of evergreen cuttings. In these instances some heat has been applied to maintain air temperatures of 40° - 50°. In a typical operation evergreen cuttings, Yew, Juniper, etc. are stuck in ground beds in late fall or early winter. If rooting is delayed until hot weather desiccation becomes a problem, Dr. Hess advised one grower to close his house tightly. This was done and although temperatures of over 110° F were attained a good take resulted. Charlie informed me that this same grower had good results with a number of varieties of hardwood cuttings this past year.

Plants grown from seed may be started in such houses with advantages. A summer or fall seeded crop will overwinter without the losses often encountered out-of-doors. A spring crop may be seeded earlier, germinated earlier and then carried through the summer under Saran shade. If necessary the plants may be protected during first winter.

The propagator who is on a year-round program with cuttings coming off at all months of the year will find these structures invaluable in giving a balance to his operation as well as a means of rapid expansion. Faced with potential sales beyond current capacity these structures offer a means of answering the door when opportunity knocks. The plastic house may be used to harden-off the newly rooted plants, hold them in dormant storage and finally give the added bonus of extra root growth and better condition at market time in the spring.

If I may quote Bill Cunningham again, "Plastic houses are an adjunct to greenhouse use, not necessarily perfect in themselves. We feel any propagating nursery must have both glass and plastic to balance operating costs within a structure which will permit some profit".

(1) Bailey, L. H., Standard Cyclopedia of Horticulture, MacMillan, New York.

PRESIDENT VAN HOF: Are there any questions?

MR. KLAS VAN HOF: How high is your wind velocity in the winter? To me that is rather important.

DR. LEISER: It is important. There have been some bad lots of plastic that split on the seam. We lost a plastic cover last spring at Purdue. We presume it was during a 60 mile an hour gust.

MR. KLAS VAN HOF: What plastic do you recommend?

DR. LEISER: All I have used has been polyethylene.

MR. KLAS VAN HOF: There are several companies making poly.

DR. LEISER: I would go to the name brands. Beyond that, I don't want to recommend one over another. I have always used Vis-Queen. It is a name brand. If the seam splits, they will replace it. The inner liner tightly applied will give you some insurance against splitting and losing a crop. You may also use some sort of a hold-down. Bill Cunningham has gone to just plastic covered wire every 15 feet or so, the length of the house, to prevent some of the flapping, and this I understand has been a big help. It is similar to the Lord and Burnham idea of the hold downs at each rafter.

MR. JAMES WELLS: I have three questions. What gauge plastic?

DR. LEISER: We have used four mill, I believe. Bill Cunningham I believe has been using four mill all the time. Some people go to six.

QUESTION: What is the minimum?

DR. LEISER: Bill has used four and I have four on the outside and two on the inside. It depends - well, your insurance will be a lot more with the four mill on the outside.

MR. WELLS: Question No. 2. You use furring strips just to tack the plastic on the two gable ends only?

DR. LEISER: And the sides down at ground level.

MR. WELLS: At the bottom, so you have a wood board?

DR. LEISER: Wood board across the full length.

MR. WELLS: Attached to the pipes?

DR. LEISER: Attached to the pipes in the ground with the pipe straps. That is part of the lumber cost.

MR. WELLS: The third question. In your original method of fixing it, you indicated bolts with washers. Doesn't the plastic pull over those?

DR. LEISER: Bill cut out little fiberboard washers about an inch in diameter.

MR. CUNNINGHAM: About two inches square.

DR. LEISER: And it did not. This wire method of fastening I like because of its quickness.

MR. HANS HESS: You had the heater for your house. You said it was now placed in the middle. In other words, one diverting air to the one end and the other to the other. Are these both together or spaced how much?

DR. LEISER: I will refer that to Bill. Side to side or back to back?

MR. CUNNINGHAM: In the middle side by side, one directed toward each end. I want to say that the installation in the middle of the house is far more efficient than where the heaters are put on each end and directed toward the middle.

MR. HANS HESS: The reason I asked that is this process of investigating heating in a plastic house - I was advised by a heating engineer that in a 100 foot house you would have to have them equally spaced so that they could divert the heat in different directions. In other words, if we place them on each end there would not be sufficient drive to bring the air to the middle, and if you placed them in the middle and diverted toward the end, the ends would be cold and the middle would be warmer. That is what I was wondering about. I would like further information.

MR. CUNNINGHAM: In theory that might be right, but in practice it isn't true.

MR. HANS HESS: The reason I bring this up is that many times the fellow who is a heating engineer, who has not had experience with something of this sort, his theory may be correct and yet in actual practice it isn't right. You say it definitely does give you good heat distribution.

MR. CUNNINGHAM: Yes.

MR. PETER VERMEULEN: I have two questions. I am interested primarily in light. Have you made any study on light transmission, if we know red and far red is necessary?

DR. LEISER: I have seen spectral curves on poly and there are no cutouts in the areas we feel are important.

MR. PETER VERMEULEN: This is poly?

DR. LEISER: I have seen it on a number of other kinds. Fiberglas, for example. There is no cutoff in the red and far red and the blue regions that are important.

MR. PETER VERMEULEN: Have you made any comparative studies on the cost as compared with the semi-permanent type of plastic, like Mylar? We have repetitious costs in applying polyethylene every year.

DR. LEISER: No, I haven't at all. One reason I guess is that I have known half a dozen different people who have been very unhappy with Mylar. They have known it to split in two or three years. Apparently this has been a bad application. These problems have seemed to rule it out, and I haven't particularly considered it for this reason.

PRESIDENT VAN HOF: Two more.

DR. FRED J. NISBET (Asheville, N. C.): I have invested in Mylar. I had looked over Mylar houses from Mentor to Mobile and I have found too many that failed. The main cause of failure was using poor lumber, so that we stress when putting on Mylar to get it drum tight.

MR. ARIE JAN RADDER: (Conn.): We built a plastic house this fall and we inquired about a heater. We got a propane gas heater. It throws out 138,000 BTU for $175. This is a check type heater. It is ignited by a spark plug, electrically ignited. It has a fan behind it and by pulling a switch you can use the fan for cooling. I felt I should mention it since yours throws 75,000 BTU.

DR. LEISER: This is a unit heater?

MR. RADDER: It is portable. We place it in the center of the house.

DR. LEISER: Like used for corn drying.

MR. RADDER: I don't know what they use it for. We also put air conditioning pipes on it and heat wherever we want. The only thing, there might be some dead spots and I might have to put fans in it.

DR. LEISER: I inquired somewhat of this and the man selling them was afraid it wouldn't be too suitable for propagation houses because of the high heat, spot heat effect. He felt it would be too hot in some areas. If you have good luck with it, this is good news.

PRESIDENT VAN HOF: Thank you, Dr. Leiser.

Next in order is "Dwarfing of Ornamental Plants by Grafting." We tried to get it last year but something else came up. We have a capable man doing this, John P. Mahlstede. Dr. Mahlstede is from Iowa State University.

DWARFING OF ORNAMENTAL PLANTS BY GRAFTING

John P. Mahlstede
Iowa State University