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LOW-COST PLASTIC GREENHOUSES

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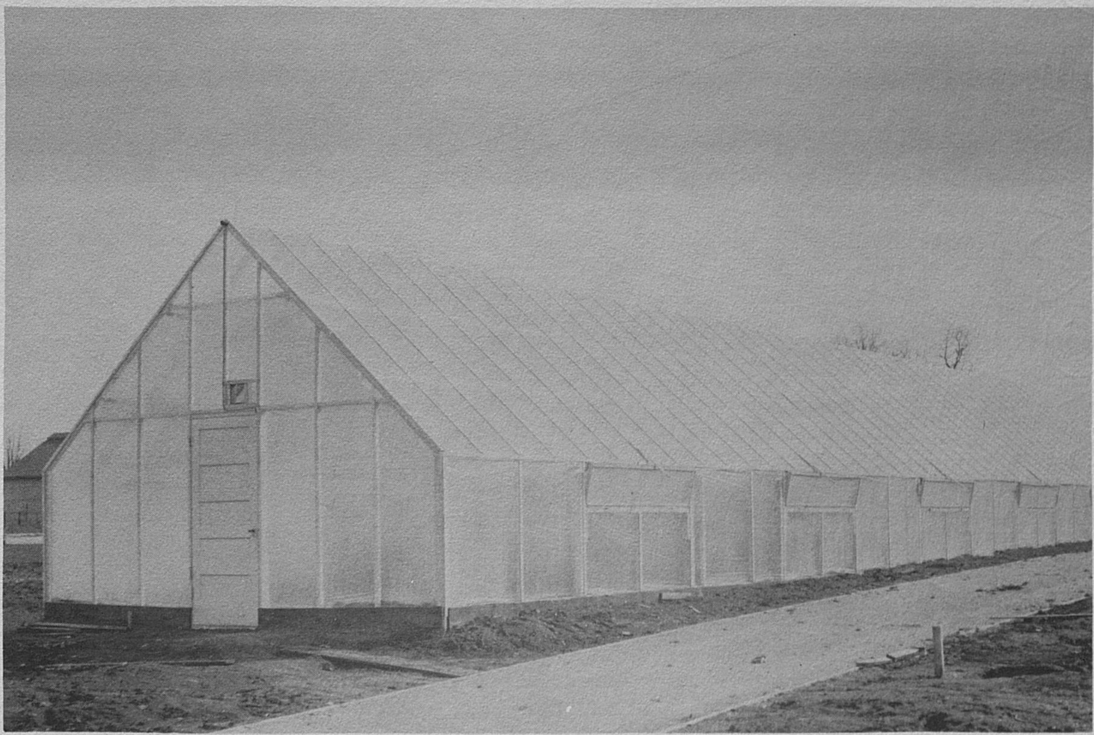

AGRICULTURAL EXPERIMENT STATION
UNIVERSITY OF KENTUCKY
LEXINGTON

PROGRESS REPORT ON LOW-COST PLASTIC GREENHOUSES

The second year's use of plastic for greenhouses on the University of Kentucky Agricultural Experiment Station Farm has given conclusive proof that good crops can be grown in such houses. For eight years good crops have been grown in commercial polyethylene houses at the south edge of Lexington, but no definite data were kept on the crops. The crops were financially successful and for this reason it was decided to release the idea to others after definite proof was established that crops grew well in them. Seemingly these houses may make it possible to grow out-of-season crops much cheaper than in glass houses because overhead and heating costs are greatly reduced.

Results with Crops

1. Bibb Lettuce.

Bibb lettuce produced extra large and solid heads in much shorter time than usual. It seemed to thrive under the conditions in the plastic house, and its quality was very good.

2. Leaf Lettuce.

Grand Rapids lettuce grew well and was of good quality; just as good if not better than when grown under glass.

3. Kentucky Wonder Beans.

The plants grew vigorously. However, there was a tendency for them to vine and not set pods, especially if the concentration of nitrogen in the soil was high. If plenty of air was admitted and temperatures of 60°F or more were maintained, a good set could be obtained. Plastic keeps the humidity too high if air exchange is not accomplished.

4. Tomatoes.

Tomatoes grown at the same time, under glass and plastic, were compared. Here again there was some tendency towards vegetation, but good fruiting occurred a little later than was true for fruit grown under glass. The fruits, though about a week later, were larger than when grown under glass and were of good quality. The yields have not been completed but appear to be about equal. There was some tendency towards rotting in the plastic house when air exchange was slow, but the glass house dried out much more rapidly and there was less rotting in it; however, there was more tendency for blossom-end rot to occur in the glass house. Blights did not seem to be worse, but there was some tendency for more leaf mold and sclerotinia rot in the plastic house. This is not bad if air exchange is kept up on all days possible. Fusarium wilt occurred in the glass house but has not yet been seen in the plastic houses. This was explained on the basis that the plastic house was on fresh soil, while the glass house was on old tomato soil. However, fusarium later appeared in a new glass house located on new soil which had been in sod.

5. Eggplant.

Eggplant is quite sensitive to adverse conditions, but in a plastic house it grew and fruited even better than did tomatoes.

6. Peppers.

Peppers grew well.

7. Cucumbers.

No extensive tests have been made, but a few vines grew vigorously and set a good crop. There was not so much mildew as in the glass house.

8. Beets.

Beets showed some tendency to large tops but grew vigorously.

9. Cabbage.

Cabbage grew vigorously and headed well.

10. Flowers.

About 10 different annual flowering plants have been tried in a small way and all did well.

Heat and Moisture Retention

The heat build-up from the sun is not so great under plastic as under glass, but the heat loss at night is less. This is good for plants. With the double layer of plastic, the loss is less than half that with glass. This was determined by testing the B. T. U. needed in a plastic house. It was found that 100,000 B. T. U. kept the house at about 60°F when the outside temperature was 0°F. By standard methods of calculation, glass house of the same size would require 200,000 B. T. U. It seems that the best insulation is obtained by maintaining about a 2-to 3-inch dead air space between the layers. If the space is much wider, convection currents cause losses. If much closer, there is not enough dead air to reduce heat radiation.

Moisture retention is much greater than with glass because plastic has no laps and is tighter. This lessens the amount of watering needed. If the houses do not get air exchange, however, there is more danger of disease. Ventilation and the application of fungicides are required.

Light Transmission

The light transmission of the ordinary types of plastic, such as Visqueen, is about 90 percent of that of glass. With Renolon the transmission is as much as 98 percent of that of glass. However, the more ultra-violet light and heat there is, the quicker the plastic deteriorates. If put on in late September, it will hold until the next June. Some new types are being tried which give promise of lasting longer, but as yet they are not available commercially.

Ventilation

So far, ventilation has been done by side drop vents and by vents in the gable ends. The difficulty of the side vents is that drafts affect the plants. Since air exchange has been shown to be very important, it seems that ridge vents should be made. Of course, the ordinary glass house machinery can be used, but this is expensive. Cheaper methods will be investigated this next year.

Another way of accomplishing air exchange is to use exhaust fans. These can be used in connection with the heating system. They can be sued to circulate the heat on cold nights. In the day time and on warm nights, air from the outside can be pulled in and distributed without draft on the plants. A comparison of this method with ridge vents will be investigated this next year. Gable-end vents would be installed on all houses.

Preservation of Wood

The plastic is extended into the ground on the sides, hence, there are no side walls. Where the supporting 4" x 4" side posts and sash bars go into the ground, they should be treated with wood preservatives. The plastic, however, lasts better under ground than above.

Steep Angle Good

The eave plates and ridge bars are made of 2" x 4" lumber. The sash bars are 2" x 2" lumber. The angle at the eaves should be 40° instead of 33° (standard house) to aid in snow clearance. Removable side post supports should be used to hold up any snow which may accumulate on the roof.

Heating

Because of its uniformity, the best heat is from hot water fins. It is more uniform than steam or hot air. However, the initial cost is high and somewhat more care is required, although the operation can be made automatic.

For small units, the use of gas heaters can be entirely automatic and the initial cost is low. The heat units (B. T. U.) from natural gas cost somewhat more than those from coal, and those from propane cost considerably more, but the handling of coal and ashes is costly on small units. For this reason, work is being done with gas heaters.

It was found that propane gas, if combustion is complete, gives off only CO_2 and water. If the CO_2 is not too concentrated, it helps plant growth.

If vents are used, propane works well. The vents do not have to be especially tight so that some CO_2 can escape, but a good share goes outside. If natural gas is used, care should be taken to have tight vents because some types of natural gas harm plants. Be sure to have burners that give complete combustion. Incomplete combustion gives off aldehydes and other products which are harmful to plants.

The Bluegrass Butane Company, 2417 Nicholasville Road, Lexington, Kentucky, has a good burner. The L. B. White Company, Onalaska, Wisconsin, has a forced-draft burner which is good for large houses. The smaller burner is also good for smaller houses. They also make blowers for air exchange and hotbed heaters.

A new heat distributor duct made of pigmented polyethylene is attractive and is much cheaper than pipe. Plain white plastic can be used but does not radiate too well. The first trial using polyethylene laminated aluminum at Lexington gave exceptionally good results. Tomato plants set next to the outside grew fine in subzero weather. This was due to the fact that the soil is warmed as well as the air by this method. These ducts are made by placing wire wickets every 2 feet and covering them with plastic. The edges are made air-tight by the use of soil. A blower forces the heat through this tunnel.

Fastening the Plastic On

It is best to run the plastic the long way. If the house is 84 feet long, 85 feet of the plastic is rolled on a pipe or stick 6 inches longer than the plastic on each end. One man tacks the plastic at one gable next to the top. The other takes hold of the roll and rolls out 6 or 8 feet, or over 3 or 4 sashbars, and pulls tightly on it. The other tacks the lath on down to 8 inches of the lower edge. The next length is placed under the 8 inches so that there is a lap of about 6 inches, and tacked in the same way. If the lap is about 6 inches and the plastic is pulled tightly, there is no need of sealing the laps since they will stay together even in strong winds. The inside layer can be put up with paper disks and tacks since the wind does not get to it.

New Plastic House on the Station Grounds

A second house was tested this spring. It was covered with Reynolon and Shellmar sheeting. The Reynolon admits more light than any of the plastics because it is clear. Shellmar sheeting was clearer than Visqueen. It seems that both of these polyethylene plastics held up exceptionally well and plants did fine under them.

Sources of Plastic

A Louisville firm makes polyethylene plastic especially for greenhouses; it is Peter and Company, 3618 Lexington Avenue, Box 12, Louisville 6, Ky. Convenient rolls of the right width and thickness are available.

Other sources of plastic in large amounts include E. I. DuPont DeNemours & Company, Film Department, 1007 Market Street, Wilmington, Del. (56 inches is the widest they have). A firm having 72-inch material (Shellmar sheeting) is Continental Can Company, Mt. Vernon, Ohio. Another product, which is somewhat clearer, is called Reynolon. This can be obtained from Reynolds Metals Company (Do-It-Yourself Division) Louisville, Ky. The Visking Corporation has plastic of wider widths, but the cost of wider widths is some what higher. Medium-wide widths are easier to put on. The 0.003" gage is available, and under some conditions, especially at the top of the greenhouse, it may be good to use this heavier gage.

(Mention of commercial products in this report is made only for purposes of information. The Agricultural Experiment Station does not guarantee nor warrant the standard of the products and the use of the names in this report does not imply the approval of these products to the exclusion of others which may also be available.)

Cost Estimate

Since the project has started, the cost of plastic has dropped about 12 percent. To cover an 18' x 84' house, the cost is only about $24 for the outside layer of 0.002" plastic and $15 for the inside layer of 0.0015" plastic. This is based on large quantity, wholesale prices. Plastic in small amounts costs more. The framework cost varies from $150 to $250.

A blueprint for the 18' x 84' house is available through the Agricultural Engineering Department, University of Kentucky, Lexington, Kentucky, for 10 cents.

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