PLASTIC GREENHOUSE REPORT-1962*

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Testing of plastic film greenhouse coverings was continued during the past year on both the rigid framework and air-supported structures.

Plastic films under test on the rigid framework house were attached to 2 x 2-inch wooden rafters spaced 2 feet apart. Lath battens nailed at approximately 6-inch intervals were used to fasten the film to the rafters. Each sectional (panel) to which the plastic was attached was approximately 2 x 11½ feet in size. This structure was unheated throughout the year.

The air-supported structure was erected in September, 1959. It measures 20 x 57 feet and was heated with air drawn from the corridor of a conventional glass greenhouse.

According to official Weather Bureau records taken at International Airport in Minneapolis, the winter of 1961-1962 was quite severe. Snowfall totaled 81.3 inches while the average is 40.2 inches. The greatest continuous snowfall was 12.4 inches on March 11 and 12. The lowest temperature of the winter was -32°F. on March 1. There was a total of 48 days with a minimum temperature of 0°F. or below. Because of these conditions, the winter of 1961-1962 was a very fine test winter.

A severe test was also provided by a hail storm which struck an area on the north side of the Twin Cities on June 23. Hail stones the size of large golf balls, driven by a strong north wind, pelted all greenhouses on the St. Paul Campus for approximately 20 minutes.

Rigid-Framework Structure

All films on the rigid framework structure were punctured or broken by the hailstorm of June 23. The durability of the film prior to that date and the degree of damage caused by the hail provided some interesting observations

0.005 inch (5 mil) weatherable Mylar was installed on one section on the south slope in October, 1957. Although one section does not provide a foolproof test, it has still provided some information. Marks on the surface of the film indicated unsuccessful attempts to break it with sticks or similar objects during the past year. It remained intact until the hail broke it into pieces.

A large commercial house which had been covered with Mylar in the fall of 1961 provided an interesting comparison. This house was also in the path of the hail. Both large and small holes were scattered about the house, and depressions or markings were evident where the hail did not break the surface. The owner noted that the hailstones had sharp or jaggered edges which probably helped break the Mylar. Adjacent glass houses had many more holes than did the Mylar house. The new Mylar appeared to be more resistant to breakage than was the Mylar that had been exposed to the elements for approximately five years.

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0.005 inch (5 mil) Scotchpak a polyester film reinforced with nylon mesh, was installed on four sections on the south slope and four sections on the north slope in July, 1959.

Cuts were noted in some of the panels on several occasions. Some of the cuts were mended with Mylar tape applied to the inside surface. The tape held well for over two years, but it started to separate from the film in the area of the cut surface during the third year. None of the tape was applied to the outside surface. Unrepaired cuts did not spread because of the nylon mesh reinforcement.

A separation of the film layers was evident in panels on the south slope beginning in October, 1961. This condition was first evident where heat was reflected off the wood sill near the base. The upper half of one panel broke out by November, 1961 and some holes were evident in all four sections by May 17, 1962. The nylon mesh had weakened and broken by this date. No breakdown was visually evident in the panels on the north slope by June, 1962. There were some man-made holes present. The plastic on three out of four sections on the north slope were broken out by the hail. The remaining one, plus the four sections on the south slope, were riddled but not broken out.

0.004 inch (4 mil) DuPont's long-life polyethylene was applied to one section on the south slope and one section on the north slope on October 15, 1960. This material was more cloudy than regular polyethylene, and was withdrawn from the market shortly after it was applied to the test structure. The section on the south slope showed evidence of small holes and breakdown by October 26, 1961 where heat was reflected off a wood sill near the base, and the section required replacement in November, 1961. As of September 20, 1961, the section on the north slope showed only a few small holes, apparently not caused by the elements. These holes did not spread until the section was filled with holes by hail on June 23, 1962.

0.004 inch (4 mil) Gering's 601 long-life polyethylene was applied to one section on the south slope and two sections on the north slope on October 15, 1960. Most of the section on the south slope had broken out by September 20, 1961. On the north slope small holes had been poked in the film on one section by August 24, 1961, but no further damage was evident until a large tear developed near the top by November 10, 1961. The panel broke out shortly thereafter. The second section on the north slope remained intact until January 29, 1962, when a large hole near the top and a second near the bottom were noted. These holes enlarged gradually thereafter.

A new supply of the 601 film was applied to four sections on the south slope and one section on the north slope on November 19, 1961. All sections were intact until June 23, 1962, except for small man-made holes. The plastic was riddled by the hail, but it did not break out of the frames or tear further thereafter.

0.004 inch (4 mil) regular polyethylene was applied to one section on each slope on November 19, 1961. Both sections were intact until riddled by the hail.

Air-Supported Structure

Particulars concerning the operation of this greenhouse prior to October, 1961 were provided in previous publications (1, 2).

The 5 mil Scotchpak used to cover this house was a year newer than that applied to the rigid framework house, and differed in that the strands of the nylon mesh were a little closer.

A separation of the layers of film comprising the Scotchpak was evident near the point of attachment to the west end wall by October 30, 1961. The film in this area was subjected to considerable flexing when the wind blew, causing the whole top covering to shift on its cushion of air. Soon thereafter the same type of separation was evident near the point of attachment to the east end wall. No such separation was evident elsewhere on the film. Despite the separation, the inside layer and the nylon mesh of Scotchpak remained intact. The outside layer in this area had broken away to some extent.

First observations indicated that the hail stones formed little depressions without breaking the surface where they contacted the plastic. Later observations showed that the outer layer of film was broken along strands of the nylon mesh. Despite this break of the outer layer, the nylon mesh and the inner layer remained intact. The cushioning provided by the air pressure inside the house apparently enabled the film to withstand the force of the hail without developing holes. Even though the house survived the hail storm, it is no longer standing. During a heavy rainstorm on August 22, 1962 the inner layer of the film and the nylon mesh broke in some areas on the east end next to the point of attachment to the end wall.

Discussion and Conclusions

Mylar (5-mil) in a small scale test lasted for five years despite the efforts of youngsters to break the film. On the other hand, Mylar, which appears to be stronger than the other films tested, can be broken by a severe hail storm.

Scotchpak (5 mil) remained in good condition for 3-1/4 years on the south slope. Results on both structures indicated that the nylon mesh contributed to the lasting quality of the film, by preventing the spread of holes poked and cut in the film. This material is no longer being manufactured.

Long-life polyethylene (4-mil) applied in 1960 lasted longer than the check or regular polyethylene in some instances, especially on the north slope. It did not, however, remain intact through the second winter. Unless the film remains intact throughout the second winter, it has relatively little advantage for greenhouse operators in the northern part of the country. Unfortunately, film applied in 1961 was completely destroyed by hail in June, 1962. As a result, no additional information concerning its lasting qualities are available at this time.

The air-supported greenhouse remained intact for three years. In this period it has been exposed to many extreme weather conditions including a severe hail storm, heavy, wet snow and both high and low temperatures. It has also survived power failures on occasion. These advantages must be weighed against the disadvantages, the biggest of which is the cost of the reinforced plastic when the temporary nature of the building is considered. Although it is not anticipated that this type structure will replace other types of greenhouses, it would seem to have earned its place as a temporary structure.

References

1. Widmer, R. E. Report on plastic greenhouses. Minnesota State Florists' Bulletin pp. 1-7, October 1, 1960.

2. Widmer, R. E. Progress report on plastic greenhouses 1961. Minnesota State Florists' Bulletin pp. 4-7, October 1, 1961.

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